Compressed Air Magazine

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- CONTROLS PLANT AIR SYSTEM
- INDUSTRIAL WASTE

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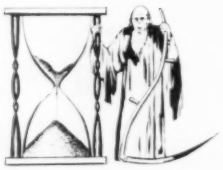
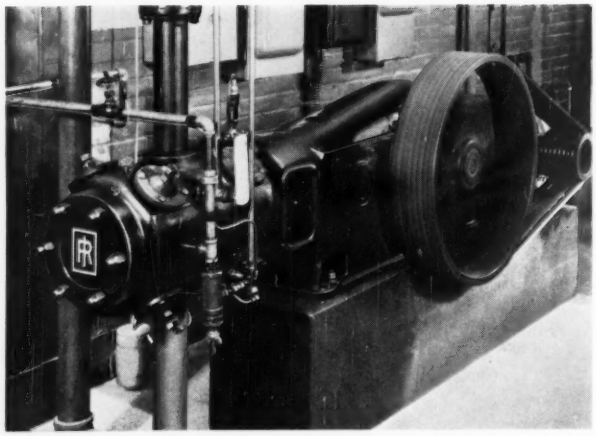
Top: this 20-hp Ingersoll-Rand ES air compressor has served the G. E. Prentice Manufacturing Company for 12 years with no part replacements. Bottom: new 25-hp ESH compressor, added for increased capacity.

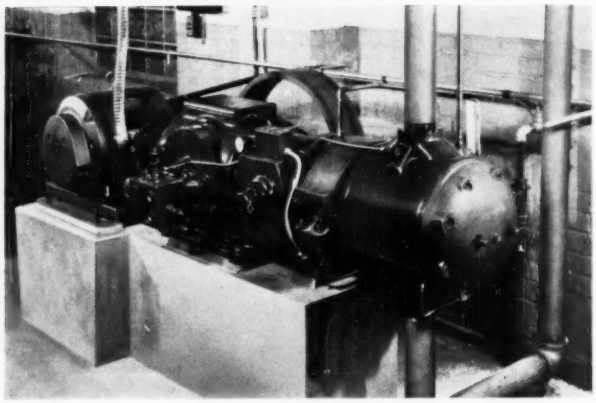


IN I-R COMPRESSORS,

TIME TELLS

THE DIFFERENCE





12 years as full-load compressor...

43,560 HOURS

with no parts replaced!

In 1947, the G. E. Prentice Manufacturing Company of Kensington, Conn., installed an Ingersoll-Rand ES compressor to supply the air power for production of metal stampings. Since then, the compressor has been on duty through every shift, and has totalled more than 43,560 hours with no part replacements on valves, cylinder, or running gear!

The Channel Valves were inspected twice a year and cleaned when necessary, but no parts were replaced. The cylinder bore and rings are still in perfect condition.

Recently, a new Ingersoll-Rand ESH compressor was added to take care of increased capacity demand. The ESH is the successor to the ES, and offers many new *extra-value* features, such as full-floating aluminum bearings which never need adjustment, sealed frame which keeps out dirt (the major cause of wear), complete filtered pressure lubrication, and self-adjusting metallic packing. And of course, Ingersoll-Rand's famous air-cushioned Channel Valves with reversible seat plates.

Ingersoll-Rand offers the most complete line of compressors, in reciprocating, centrifugal, rotary and ejector types. There are units from ½ to 20,000 hp, for pressures from one micron to 35,000 psi. Your I-R man can give valuable help with your compression needs – call him today.

Ingersoll-Rand

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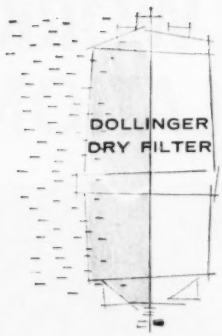
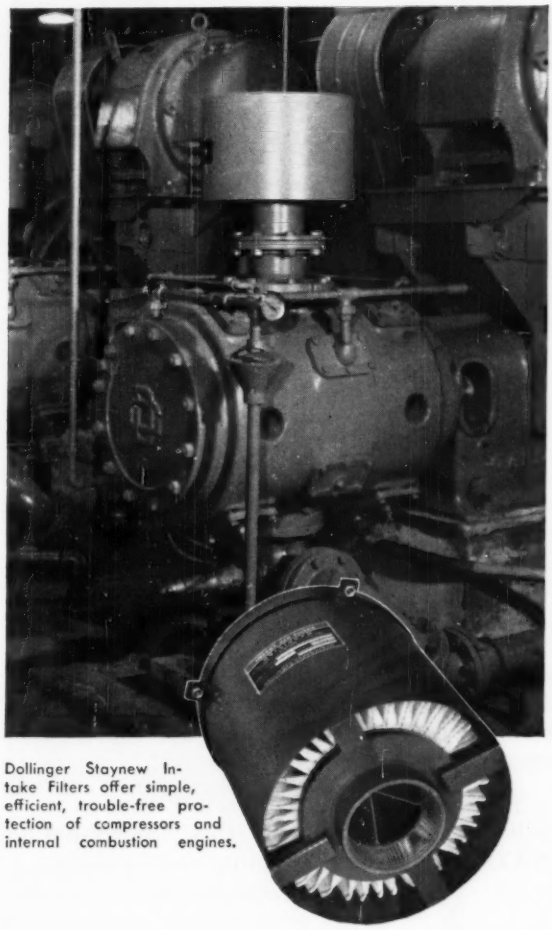
The World's Most Comprehensive Compressor Experience



IMPROVE COMPRESSOR PERFORMANCE BY SIMPLE, EFFICIENT REMOVAL OF DUST



Dollinger Staynew Intake Filters offer simple, efficient, trouble-free protection of compressors and internal combustion engines.

Dollinger Staynew Intake Filters are designed for direct application to engines, compressors and blowers, or to outdoor piping without the need for foundations, supporting frames, or weather louvers.

Constructed for maximum efficiency. Staynew Intake Filters are supplied with the finest filtering medium available, and—with the exclusive Radial Fin design—provide the greatest active filtering area in any given space. They exhibit very low pressure drop, and operate for unusually long periods of time without maintenance. Threaded pipe connections or flanges make for ease and solidity of installation. For cleaning and inspection, the weather housing does not need to be removed.

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HOW TO TAKE TIME AND WORK OUT OF PIPE LINE INSTALLATION

NAYLOR Wedgelock couplings make a positive connection, securely anchored in standard weight grooved ends.

To help contractors get the job done faster, easier and more economically, NAYLOR offers a pipe and coupling combination to simplify pipe line installations.

NAYLOR's exclusive lockseamed, spiral-welded structure gives you pipe that is light in weight without sacrifice of strength and safety. It's easy to transport, handle and install—saves time, trouble and money right down the line.

WEDGELOCK couplings fit into this economy picture, too. They simplify and speed connections since a hammer is the only tool required to connect or disconnect them, and joints can be made up with only one side of the pipe in the open.

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Write for Bulletin No. 59.

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Compressed Air MAGAZINE

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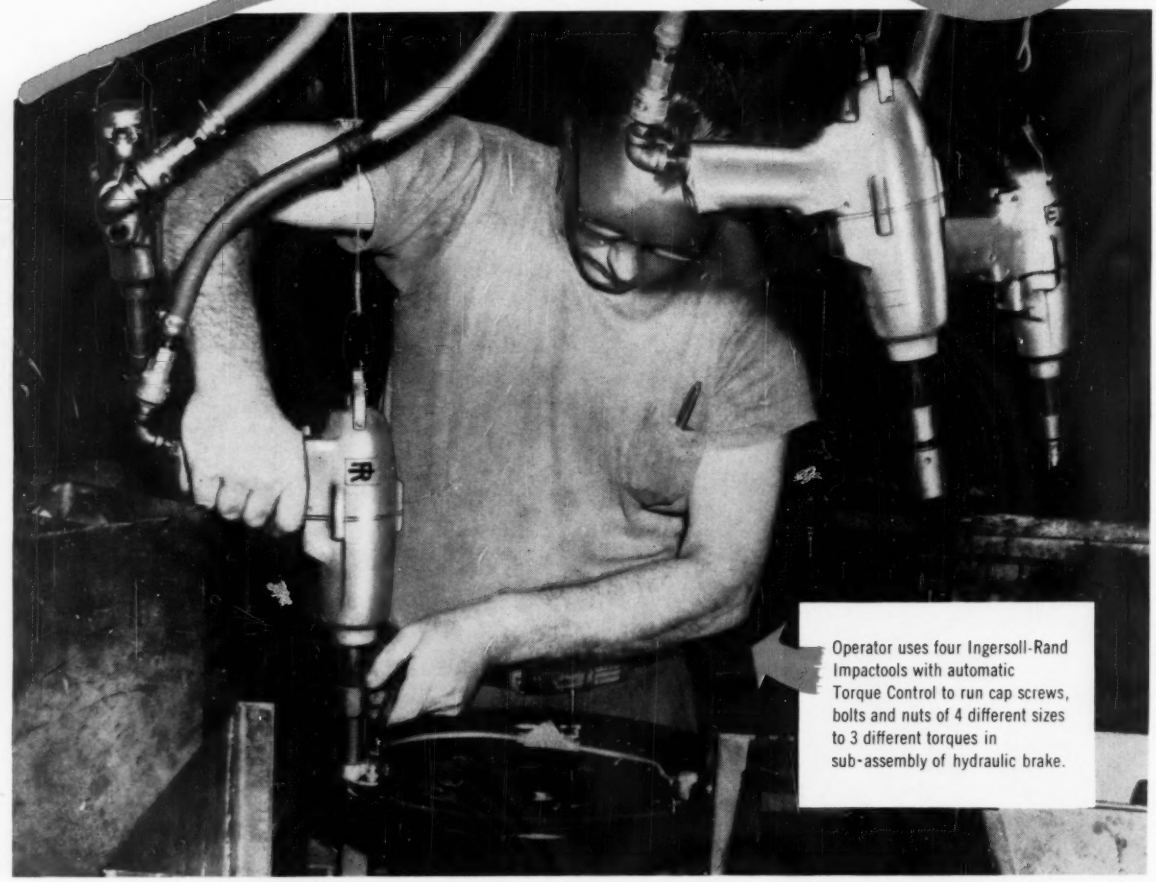
on the cover

Some 40,700 feet of tubing went into this intricate scaffolding prior to the erection of a dam-access bridge in France's eastern department of Savoie. At the top can be seen the arch that today supports the bridge. Entrepose, a French company that specializes in such spiny tubular structures, built the scaffolding. Span is 135 feet; height of the arch is 105 feet; 8700 couplers hold the many tubes together. Though the piping must support the weight of the whole bridge, it weighs less than 1 pound per cubic foot of space occupied. Total weight of the scaffolding is 147,000 pounds.

IMPROVE PRODUCT QUALITY PRODUCE 45% MORE AT THE SAME TIME!



Operator uses four Ingersoll-Rand Impactools with automatic Torque Control to run cap screws, bolts and nuts of 4 different sizes to 3 different torques in sub-assembly of hydraulic brake.

By replacing ordinary air and electric impact wrenches with Ingersoll-Rand "automatic shut-off" torque control Impactools, the problem of driving cap screws, nuts and bolts to 3 different and precise torques has been eliminated. Quality is assured!

At the same time . . . production on this job has increased by 34% to 45% per manhour depending on the model being assembled! And . . . this manufacturer has solved his "quality bottleneck" on 11 other operations with additional reliable high-production, Torque Control Impactools.

This extra output means a Dividend on Payroll Dollars for this manufacturer of from 34% to 45% of the operator's wages!

You can calculate your own dividend with the help of Ingersoll-Rand's new, illustrated guide-book, "How to earn a Dividend on Payroll Dollars with Planned Annual Retooling" . . . and handy Dividend Computer. Call your nearby I-R Representative or write Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

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Planned Annual Retooling increases output per man

43A-8

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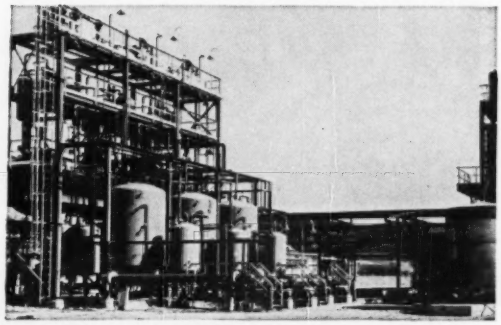

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Reliability and the Lightweight Casting

G. R. Smith

RESTLESS in their quest for that elusive genie named Reliability, the builders of today's spacecraft work feverishly. They are seeking to bring the technology of space flight up to the level of the astrophysicists' laws. But the builders have a disadvantage. Working with the laws is mainly a matter of the mind; once conceived, the laws can be jotted down, passed from person to person and applied. Working with metal is different. No matter the beauty of the paperwork, the metal still must be physically poured, milled, drilled, finished or whatever is needed to attain specifications. This is the work of the fabricators.

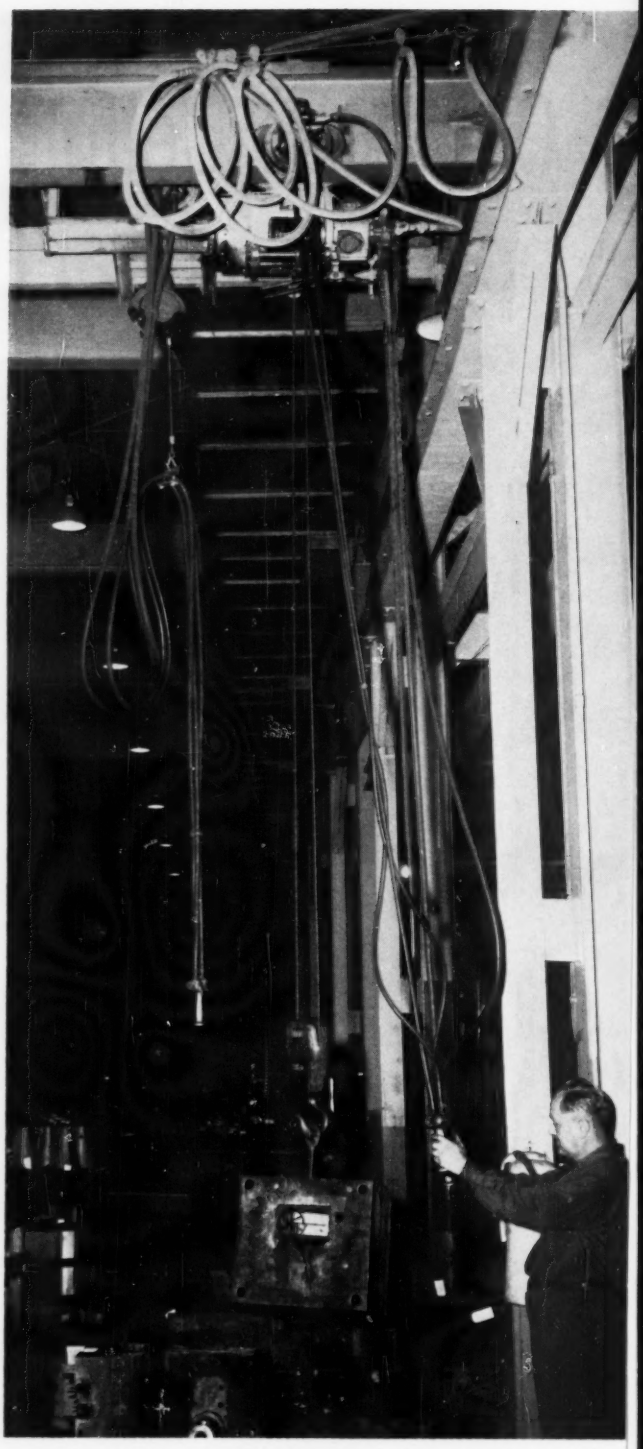
One manufacturer involved in this surprisingly down-to-earth business of making space metal is Bendix Foundries, Teterboro, N. J. The company is one among a complex of 25 divisions and 16 subsidiaries and affiliates in the vast Bendix Corporation.* Though the huge parent corporation pours out diverse products (ranging from nuclear reactors to bicycle brakes), the job of Bendix Foundries is easily described. It produces castings of aluminum or magnesium and their alloys.

Three main shops make up Bendix Foundries at its location in the shadow of busy Teterboro Airport. There are facilities for nearly all of today's production casting methods: sand, permanent mold, die-casting, centrifugal, shell mold, and plaster-ceramic mold types. Every lump of metal that is shipped from the foundry is obtained on a job-shop basis by salesmen traveling the country for orders. As would be expected, some business comes from other divisions of Bendix, but is received only after competitive quotations.

Having sprung from a company that helped pioneer the aviation business, Bendix Foundries' personnel are thoroughly familiar with the old taskmaster, Reliability. The foundry has matured as higher and higher quality has been demanded.

To a person just joining Bendix Foundries, however, the concept of highly critical quality can come as a shock. The first thing needed is a cleansing of the mind, a shift in thinking away from conventional founding practices. One company official recently started with Bendix Foundries after several years of supervisory work in foundries outside the aviation and space business. Here is how he put it: "It used to be that castings were okay if you held them up to the light and couldn't see through them. Today we scrutinize them with X ray, fluoroscope, ultraviolet light and acid etch to make sure we have good ones."

Bendix Foundries is reluctant to give details on the specific castings produced there, probably for both classified and competitive reasons. Many of the cast-



THREE AIR USES Before castings can be made, heavy dies must be moved to casting machines. This bridge crane uses air in three mechanisms. The hoist moves loads up and down. Above, on the beam, an air-powered trolley takes the hoist across the width of the shop. And another air-motor-powered propelling motor, with a chain drive, moves the entire beam and hoist arrangement the length of the shop. One man controls all three throttles at one location.

* Although 57 percent of the parent company's 1959 sales of $684,000,000 came from aviation products, The Bendix Corporation recently deleted the word "Aviation" from its name.

ings are simply lightweight pieces made to fairly stringent tolerances. Perhaps an automobile manufacturer finds a part where magnesium or aluminum can save weight or do a job better than steel. Or perhaps a calculating machine or typewriter manufacturer needs a run of an intricate lightweight section. Such tasks make up a respectable percentage of the production. It can't be denied, however, that much of the work at Bendix Foundries is for the aviation and missile industries. Understandably tight-lipped about details of specific components produced, the company spokesman mentioned above stated simply: "About 75 percent of what we make leaves the ground. About 50 percent of what we make leaves the ground with somebody's life depending on it."

To describe the foundry's operation and to point out the important role that compressed air plays there, one might select the die-casting shop. This operation is housed in a single building about 75 yards long by 25 yards wide. It operates as a self-contained unit. All work flows in one direction and is as efficiently set up as any comparable shop today. Job-shop founding has never lent itself particularly well to the assembly line.

Die-casting is one of the more recently introduced casting methods. Basically it consists of forcing molten metal under high pressure into steel dies. Because of the control possible over the injection of the metal into the mold (die), this type of casting is often especially well suited for intricate work. Close tolerances can be achieved, complicated detail can be accurately reproduced, and raw castings have a comparatively smooth surface as they emerge.

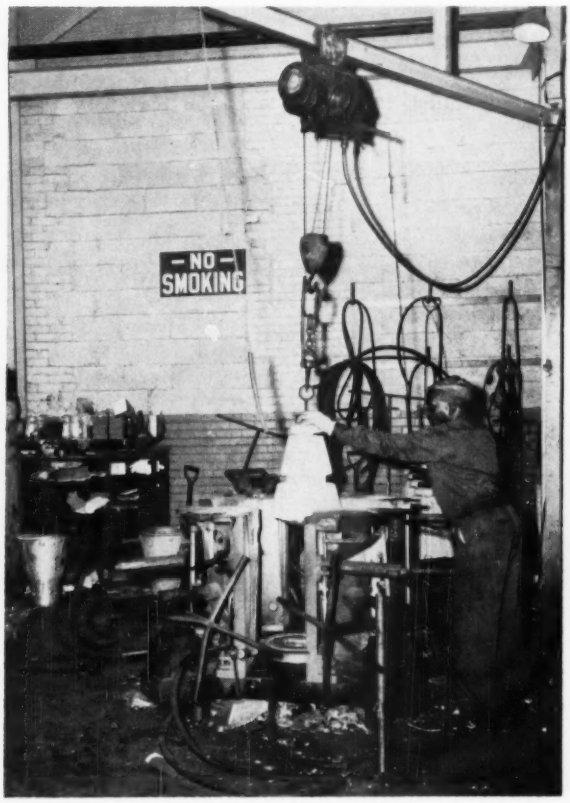
This describes the layout of the die-casting shop. At one end are five furnaces that supply the molten aluminum and magnesium. In a row are two Eclipse 1500-pound gas-fired reverberatory units (so named because heat reflects from the furnace roof back down to the metal); two gas-fired Lindberg Fischer magnesium furnaces of 600-pound capacity; and one 100-kw 1600-pound Ajaxomatic electric furnace. Also at this end of the building is a semipermanent mold casting set-up. ("Semipermanent" because the outer part of the mold is metal whereas the core is sand.)

Running the long dimension of the building are ten die-casting machines. These consist of eight Lester Phoenix and two Cleveland units. The Cleveland machines feed molten metal into the casting process automatically. Six of the Lester Phoenix die-casters also are automatic and two are manually operated. Size among the ten ranges from 400 to 800 tons of casting pressure.

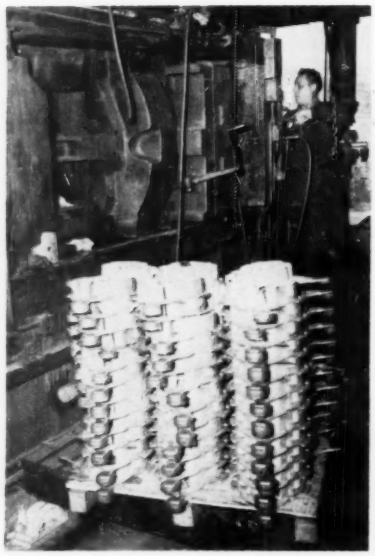
Castings are checked at the casting machine to see that they meet rough specifications. At the opposite end of the building are cleaning and inspection areas. As the castings emerge from the machines, they are first taken to the cleaning operation. According to their shape and the finish desired, they are variously sawed, die-trimmed, stamped, scraped, filed and eventually sandblasted.

Following sandblasting, dimensions are verified and internal structure is thoroughly scrutinized. Several methods are used, varying a good deal with the individual type of casting. There are facilities for visual dimension and overall checking, Zyglo (searching for imperfections with ultraviolet light), acid etch, and X ray and fluoroscope. Actually the quality control began before the castings took on their present shape. When the metal was in the furnaces, a

SEMIPERMANENT MOLD Down into the mold goes this disposable sand core, lowered by a 1000-pound capacity jib-mounted air hoist. This operation is "semipermanent" because the core is only used once but the outer mold is permanent.



POURING Held by the same hoist that placed the core, the lightweight molten metal flows into the mold. The hoist supported the ladle as the metal was taken from an electric furnace nearby. This operation occupies one corner of the die-cast shop.



sample was taken and tested on a direct-reading spectrometer that enabled fast and precise chemical analysis. If the metal didn't meet specifications, elements were added to bring it up to the correct composition.

With all this emphasis on making a high-quality, highly reliable casting at a profitable rate of speed, Bendix Foundries can't have its men worrying about handling of materials. This is where the usefulness of compressed air power is felt, for most of the lifting in the shop is done with air.

Rolling back and forth above the entire shop are bridge cranes with air hoists that do the heaviest work. Spotted at sites of higher activity are smaller air-powered hoists that lift lighter loads.

Starting in the corner at the semipermanent mold setup, here are a few of the jobs that are carried out by compressed air. An air hoist is used to place the sand core into the semipermanent mold; air lifts the small ladle to the furnace for the molten metal and holds it during the pouring into the mold. After cooling, castings are removed from the mold with the same Ingersoll-Rand 1000-pound capacity hoist. Along the entire length of the building, opposite the ten die-casting machines, is a bay where dies are stored. Row on row of these blocks of steel rest on shelves about 8 feet high. The traveling cranes are used to wield these heavy dies to and from the casting machines. In all, the shop has one 6000-pound, and three 4000-pound capacity Ingersoll-Rand air hoists moving overhead on traveling cranes.

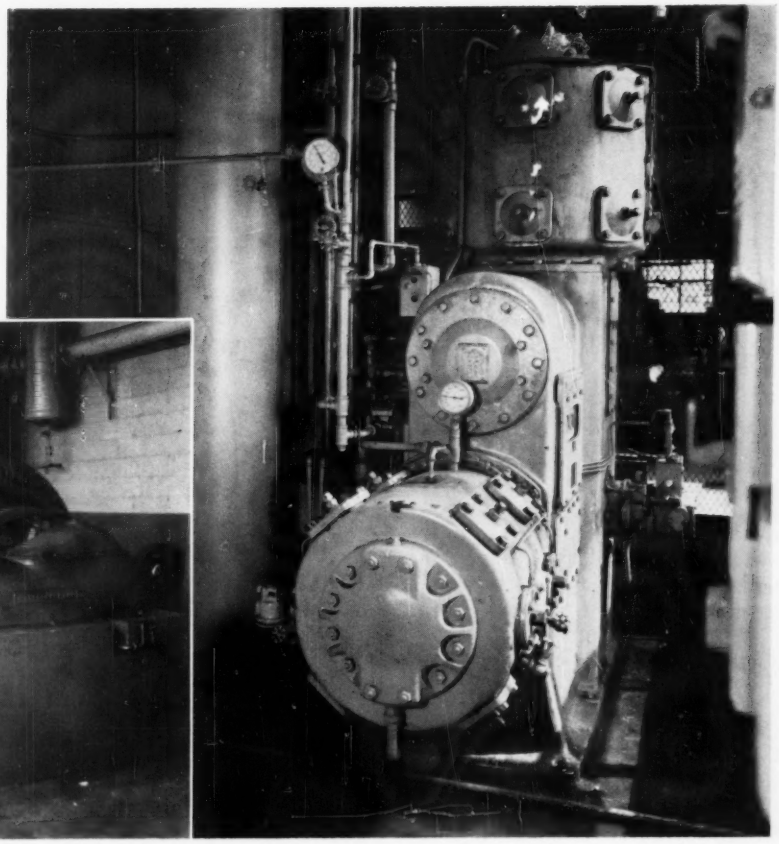
Movement of these hoists is entirely the work of compressed air. It powers the hoists, which give vertical movement. Air-motor-driven trolleys on the beams above move the hoists the width of the die-cast shop. And air-powered bridge-crane propelling motors drive the entire beam and hoist assemblies the length of the building. Air, therefore, allows the hoist operator to move his load conveniently in all three possible directions. The hoists are Ingersoll-Rand Sizes B, C, D and D6 units; the propelling motors are I-R Size CCM's. Handy thumb-actuated pendent throttles control feed of air to most of the hoists. The hoists and propelling motors incorporate variable speed control, an important feature for foundry operations such as carrying cores and spotting ladles.

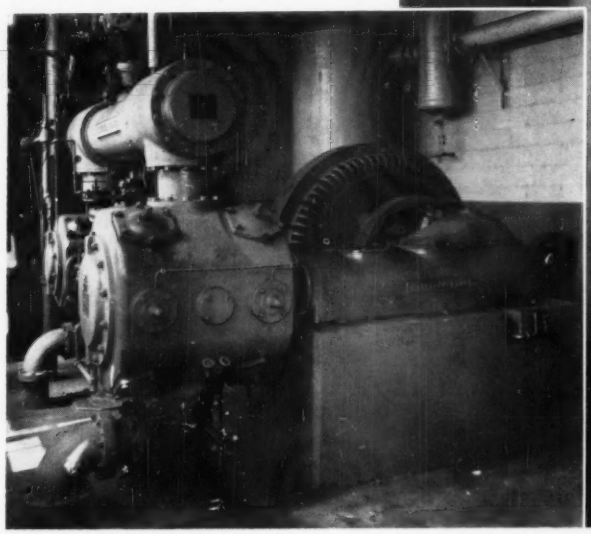
As well as handling dies, these hoists are put to work moving the ladles of molten aluminum and magnesium from the furnaces to the die-casting machines. The metal first is poured from the furnaces into a ladle resting on a jitney. This jitney moves a short distance to an air hoist where the ladle is lifted several feet. The hoist and ladle travel the length of the building to feed the reservoirs.

Compressed air is applied in other ways throughout the shop. One application is seen in the huge air cylinders on the rear of the reverberatory furnaces. When it is time to fill the ladle as just described, an air valve is pressed on the furnace to be tapped. Hinged at the bottom, the furnaces tilt ahead as the pistons extend. The metal flows into the ladle.

Air is also used between casting sequences. When an operator has re-

PLANT CYCLE At the top of the page, molten metal flows into a ladle from a gas-fired reverbatory furnace. Air cylinders (one is visible at the rear of the furnace) raise the unit. Supported by an air hoist, the ladle is moved to a casting machine (next lower picture) and the hot liquid pours into a reservoir. The next photograph shows a skid of newly cast aluminum shapes resting in front of a die-casting machine. Another casting is about to be made. Air pressure is used between casting operations to clean the die, as seen in the shot immediately above. The two illustrations on the next page show cleaning and inspection. Using a dial indicator, a workman checks casting dimensions. In the other picture, ultraviolet light (Zyglo) plays on finished castings to reveal pits, cracks, etc., that can't be seen in normal light.

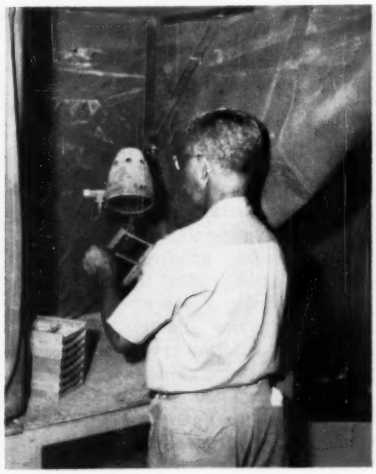




AIR SUPPLY All three shops at Bendix Foundries receive air from the Ingersoll-Rand XLE compressor, shown in the larger picture. The inset is an XRE stand-by unit. Air handles most of the lifting in the die-casting shop.

moved one fresh casting from a machine and is ready to cast another, he first sweeps the die clean with a blast from an air gun.

Besides its ease for handling dies and ladles, tilting furnaces, and cleaning dies, air has another advantage not so obvious. A good deal of the work in the shop is with magnesium. This metal must be handled gingerly for once ignited, it burns with a brilliant, hot flame that is a terror to extinguish. As with all industrial blazes, the best way to stop a magnesium fire is to make sure it doesn't happen. With compressed air there is no danger of sparking and the fire risks are reduced just that much more.



All three of the shops at Bendix Foundries make use of air as a big labor saver and are served by a central air plant with two compressors. One, an XRE, is on stand-by. The main unit is an Ingersoll-Rand XLE—an L-shaped 2-stage compressor that is driven by a shaft-mounted electric motor (see illustration). The XLE replaced the older XRE, also of Ingersoll-Rand manufacture.

The compressors, the hoists and the other air equipment in the Bendix Foundries typify the role of today's less highly publicized manufacturers in the aviation and space race. They do their work competently and quietly to add to the production of final, highly dependable, high-quality products. When the day arrives that reaching into space is an everyday matter, compressed air will have helped make it so. Then perhaps the prideful rascal named Reliability will have been tamed once and for all.

Air-Plastered Parabola

A Graceful Memorial Arch Rises Under Air's Pressure

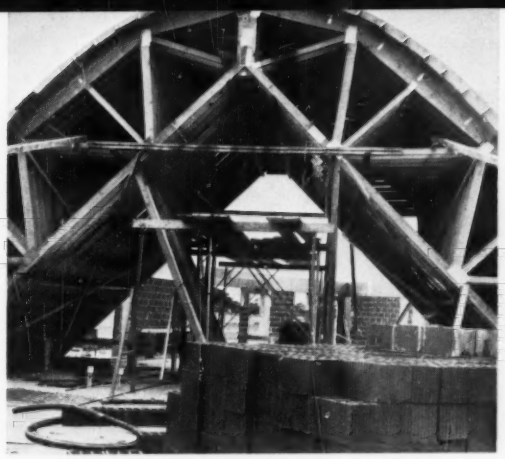
THE STRUCTURE shown in the palm tree and grass-grown setting above is an administration building for Palm Beach Memorial Park, a cemetery located at Hypoluxo, Fla., near Palm Beach. A unique feature of the building is a parabolic arch that hurdles the actual working space of the office facility. Such curved reinforced concrete shapes are never easy to build but the use of compressed air to transport concrete to the forms, and pack it tightly, eliminated much of the material-handling difficulty.

Air-sprayed concrete, in a process called Shot-Rite, was used to fashion the arch. Air for the equipment came from an Ingersoll-Rand 125-cfm Gyro-Flo portable air compressor. The pictures on the opposite page show various details of the arch's construction and operations involved in placing the concrete.

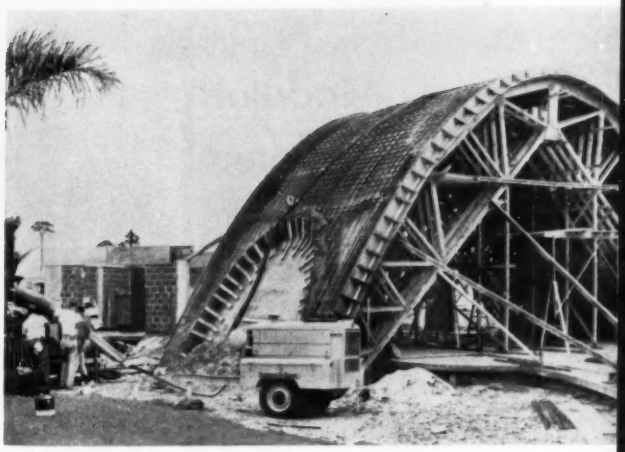
Compressed-air administered concrete is normally not applied in such a thickness. Guniting—a more common air process for laying concrete—consists of spraying a fairly thin consistency, and is popular for lining swimming pools, refacing buildings and the like. Shot-Rite differs in that it allows the use of larger aggregate: up to pea-sized gravel can be blown through the unit. Ready-mixed concrete is purchased from an ordinary supplier to feed the pressure hopper that nourishes the gun.

Palm Beach architect Howard Chilton designed the structure to blend with the modern motif of the park. The concrete-sprayed parabola spans the building's reception area. Both the east and west ends of the building have curved wings, forming semicircles that join the arch. In front will be a reflection pool with a 30-foot-tall obelisk (the needle-like structure is shown in the large picture above, and in the inset). A member formed of precast reinforced concrete, the obelisk conceals a speaker system for chimes. The pool, as yet unbuilt, will have jet-spray and underwater lights, integral with the foundation.

Inside the building will be the reception area, plus secretarial service space, private offices, a conference room, a fireproof vault and a sample display room for plaques, urns and grave markers. The front of the building will overlook a mausoleum, a colonnade and the park.



ABOVE, a heavy load of concrete and reinforcing bars is supported by this sturdy framework. Space below arch will be a reception area. In all, the cemetery building covers about 2500 square feet.



ABOVE, worksite is well shown in this view: full framework of the arch's forms, the pressure hopper at left and the Ingersoll-Rand 125-cfm compressor that supplied the air power.

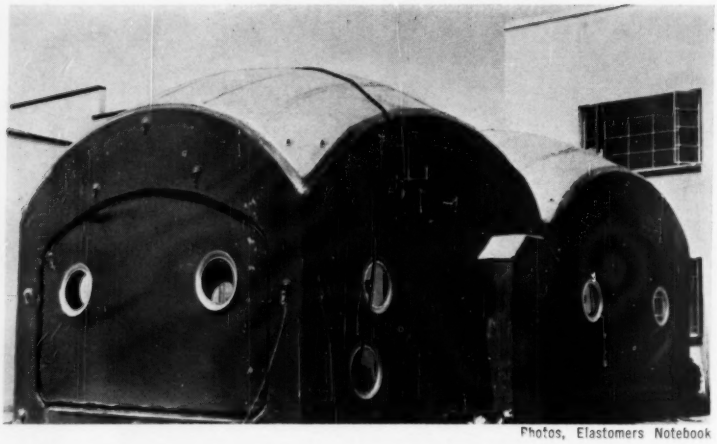
AT RIGHT, an operator begins placing concrete on the arch's plywood forms. Three-inch hose is used. Hose tenders sit on reinforcing bars above.

BELOW, concrete pours from a ready-mix truck into the pressure hopper. A nozzle on this hopper feeds the gun that lays the material. Shot-Rite's advantage is that it allows use of up to pea-size aggregate.

BELOW, architect Howard Chilton (left) checks concrete area pointed out by project manager.

Photos, Dave Webb

Modular Inflated Structures



Photos, Elastomers Notebook

UP IN New Haven, Conn., Berger Brothers Company is turning out portable shelters that do not rely upon general inflation air pressure for their stability. Structural rigidity is obtained with relatively little air volume by the use of double-wall construction reinforced by inflated internal corner posts, floor beams and ceiling "knees."

Shown at right are two 14×14×14-foot shelters joined together. A coil spring fastening system is used to install the removable wall panels and to connect one unit to another. Inflation time is about 20 minutes, with air being furnished at 10-15 psig pressure through a single roof top hose fitting from a 20-cfm portable compressor. Interconnecting hoses serve the various inflated components and each element is separately valved for easy dismantling.

Carrying out the double-wall design are double-panelled windows, clinched into port holes with aluminum frames. Neoprene gasketing is used to assure weatherproof sealing.

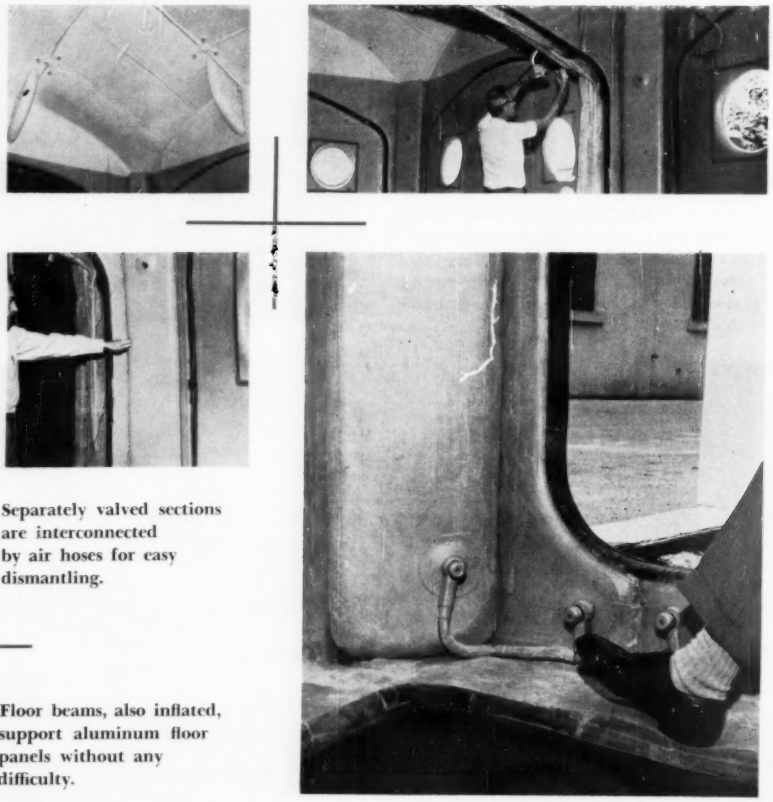
The portable shelter is stabilized by guy wires, attached to circular reinforcing patches of neoprene glued to the exterior walls and staked firmly into the ground. Thus anchored, the inflated units will reportedly withstand 100-mph winds.

Access is by means of a double-wall inflated doorway equipped with center-opening double doors. The door panels are constructed of lightweight urethane foam and are sealed top to bottom by a nylon Velcro fastener on the overlapping flaps of the fabric door covering.

The floor is supported on peripheral beams about 1 foot wide. It consists of a subflooring of expanded honeycomb paper impregnated with Du Pont's Hypalon synthetic rubber for water resistance. These panels are covered with sheets of aluminum that have been given a nonslip surface. A Hypalon-neoprene-coated fabric vapor barrier is used between the floor beam and the honeycomb.

Since each unit will fold into a compact 650-pound package that is easily transported by, say, jeep or helicopter, and since they are all designed for weather conditions ranging from −65° to +125° F, it is natural that the armed forces would be interested. The U. S. Air Force has placed an order for one of the multiple-unit systems for experimental work.

The buildings ordered had to provide a complete radio frequency shield, so all the exterior fabric was silver-metalized prior to coating. Metalized nylon curtains were hung inside the doorway and over the windows. To complete the job, a metalized nylon sheet was put around the base of the building and attached to the underside of the floor beams. The nature of the structural material responded readily to this special situation, and the Air Force may be ordering more modular inflated structures.

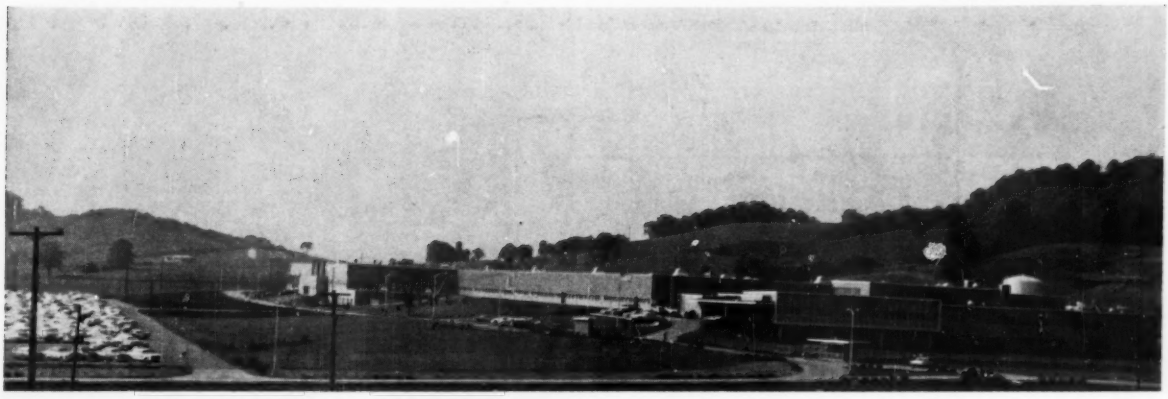


1 Inflated "knees," looking much like quarter pieces of pie, reinforce the rooms.

2 Separately valved sections are interconnected by air hoses for easy dismantling.

3 Air-filled corner posts add structural rigidity to modular pneumatic structures.

4 Floor beams, also inflated, support aluminum floor panels without any difficulty.



Stopover : Youngwood

For A Trip Through A Controls Factory

S. M. Parkhill

DRIVING westward along the Pennsylvania Turnpike toward Pittsburgh, just past the New Stanton Interchange (Route 119), motorists are attracted by a gleaming anodized-aluminum, glass and brick building that rises to the left, between the highway and the rolling hills. Set in the countryside behind a reflecting pool and gas lights, it deserves more than the motorist's casual glance. It is the new home of Robertshaw Thermostat Division of Robertshaw-Fulton Controls Company, where domestic controls for gas appliances are made. The following article will take you through this modern facility, stopping on the way to look at some of the features of the new plant, including the overhead loop air system that assures full-power air for the manufacturing set-up.

Construction of the 7.5-acre plant began in May 1959 as ground was broken on the 267-acre site. Designers Hunting, Larsen & Dunnells, Inc., Pittsburgh, had three objectives: (1) to provide a pleasant, but efficient, place for 1500 workers; (2) to provide manufacturing, testing and development facilities in keeping with the prestige of the parent company; and (3) to provide room for expansion as outlined in a 10-year projection made by Robertshaw-Fulton. The last is achieved in the plant design itself as well as in the company's land south of the present low-lying structure. The contractor, The Rust Engineering Company, also of Pittsburgh, completed its work 14 months after ground was broken and operations began in the $4,000,000 plant.

Behind the 28,000 square feet of sandwich aluminum panels and curtain walls, behind the 325,000 concrete blocks and bricks, span 284,000 square feet of manufacturing space. A walk through the receptionist's hall, where Mr. Controls is inlaid in floor tile, through the sleek 62,000-square-foot gas heated and air conditioned general office area, brings the visitor to a 250-meal-per-noon cafeteria. Beyond is the fabricating floor and its service areas—receiving and shipping departments, foundry and plating facilities, laboratories and the like.

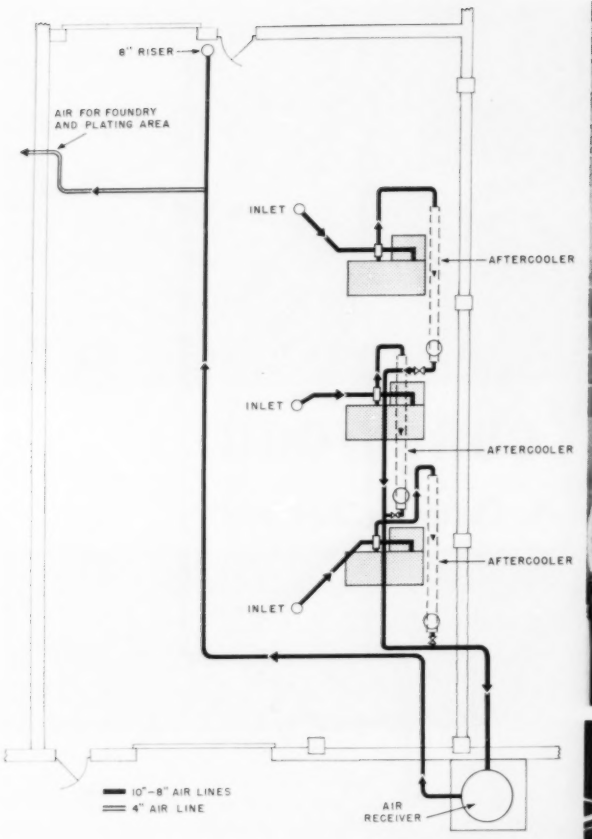
Upon first looking at the work floor, the most striking thing is the forest of utility drops—air, gas and water. (Electricity is handled by a module system of bus ducts for maximum flexibility.) Overhead are the rhythmically looping utilities systems. The hundreds of machine and hand-operated tools beneath this maze are, for the most part, either air-operated or have pneumatic mechanisms on them.

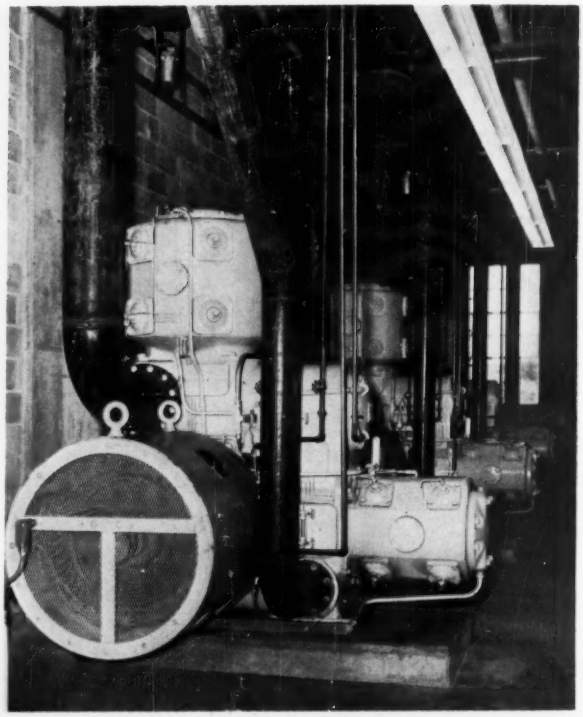
The Air System

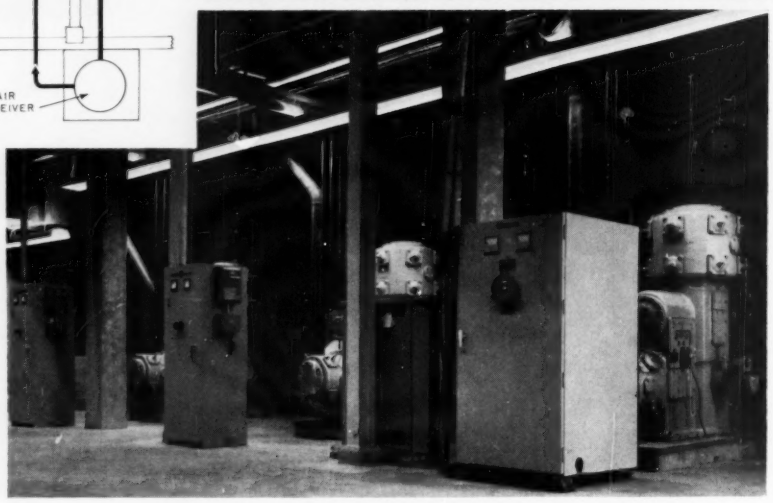
Bypassing the manufacturing area for the moment to look at the source of one of these utilities—compressed air—the visitor finds himself on a lower level. (All levels, with the exception of the general offices which are above the main conference room overlooking the lake, the home economics department and the engineering offices, are at ground elevation because of the rolling nature of the terrain.) The compressor house has, at present, three Ingersoll-Rand XLE's standing in line behind their respective control panels. Each has cylinder bores of 16 and 10 inches and a stroke of 7 inches. All are direct-connected to 600-rpm, 3-phase, 60-cycle synchronous motors—two made by Elliott and one by Westinghouse, each rated at 150 hp. The two compressors connected to the Elliott motors are controled with Allen Bradley panels; the third, a Westinghouse control panel.

For their output, these units take up very little space because of the very design of the XLE. Indeed, at Robertshaw Thermostat's compressor house there is plenty of room for additional units should these be needed later (*see sketch*). Should a 50-percent expansion occur, the same compressor installation would be adequate.

The compressors draw their air through Dollinger filters and compress it to 125-psig pressure. Need for interstage piping is eliminated because each unit has a packaged-type intercooler fitted within the compressor frame. Further, because of these short, direct passages, there is a minimum pressure drop between stages. Total air dis-







AIR SUPPLY **The drawing above is of the compressor house. The three units (shaded portions) are Ingersoll-Rand XLE's with a total discharge of 2919 cfm at 125-psig pressure. Air is drawn through 10-inch lines and is discharged through 8-inch ones. Aftercoolers are I-R Size 49PL-12, placed between the compressors and the main line. At the foot of the 8-inch riser is a drain with a $^1/_2$-inch pipe leading to the disposal plant. The two compressors in the foreground (upper right) are driven by Elliott synchronous motors; the third, direct-connected to a Westinghouse motor—all rated at 600 rpm. The first two compressors are controlled with Allen Bradley panels (right); the third, by a Westinghouse.**

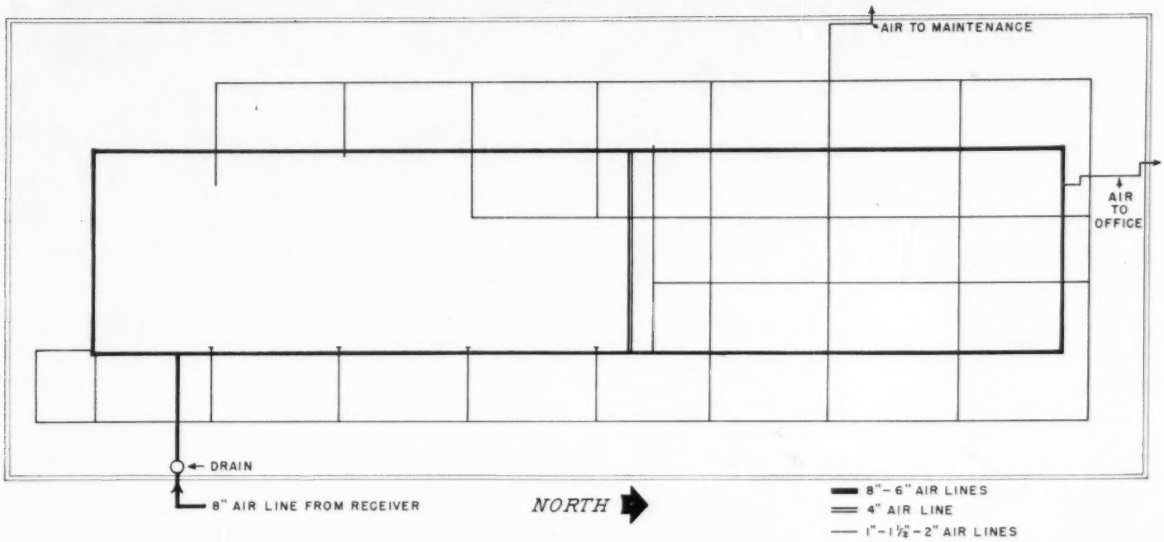
charged is 2919 cfm. (Each compressor is equipped with standard 3-step free air unloading for capacity control.) Air passes through overhead pipeline aftercoolers, also made by Ingersoll-Rand Company (Size 49PL-12), into an 8-inch line, and thence outdoors to the receiver. The air receiver is 54 inches in diameter, 14 feet high and is rated at 165 psig.

Compressed air is drawn from the top side of the receiver, again through 8-inch pipe, for use in the factory. The pipe passes the length of the compressor room to an 8-inch riser, at the foot of which is an 8-inch drain with a $^1/_2$-inch pipe leading to the disposal plant.

On the manufacturing level, the air is drawn from the 8-inch header into the principal 6-inch loop system. This loop passes overhead, a nominal 83 feet from the lengthwise walls of the manufacturing area and 54 feet from the end walls. It slants to the east for added condensate drainage through an 8-inch Murphy separator. The distance across the center of the loop, from side to side, is about 132 feet, and from end to end, 640 feet. Cutting approximately through the middle, connecting the opposing sides, is a 4-inch air pipe. Secondary loops from these 6- and 4-inch lines are fabricated of $1^1/_2$-inch pipe (*see sketch*). From these lead, 1-, $^3/_4$-, and $^1/_2$-inch lines, connecting eventually with the air drops. Throughout the manufacturing area there are 748 air drops.

Additional air is drawn from the loop system for the main offices and the maintenance shops. A 4-inch line, taken off the 8-inch header in the compressor room, runs under the floor and emerges in the foundry and plating areas, as shown in the drawing.

Compressor-receiver capacity is adequate for all of the air needed because of the very nature of the loop system. With 1600 feet of 8- and 6-inch lines, not to mention the 4- and $1^1/_2$-inch ones, the



LOOP SYSTEM Above, a simplified schematic of the air system. The principal line is of 6-inch diameter, connected through the center with a 4-inch air line. From these lead 1- to 2-inch lines, and eventually smaller ones. Throughout this manufacturing area there are 748 air drops. Some of these (along with gas and water lines) can be seen at right, where assembly of machined parts begins.

entire loop system acts in itself as a giant receiver, eliminating pulsations that both annoy operators and spoil tool efficiency. Another benefit of the loop is that no tool needing air is very far from the supply. Furthermore, air is fed two ways at once; that is, if there is a major consumption at one point in the system, air can be fed from the opposite direction to make up for the loss. In this way, tools and machines further down the line will still receive their nominal 90-psig-pressure air.

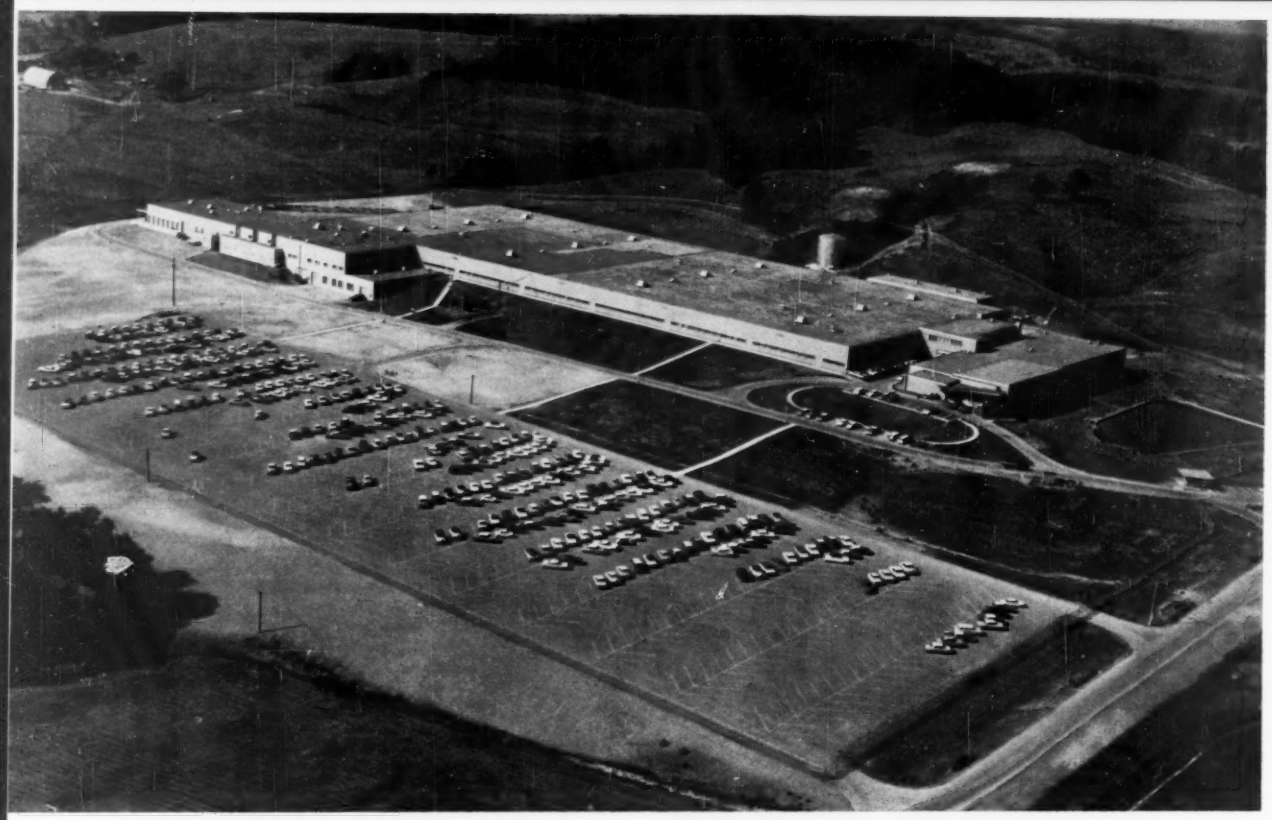
Scattered along the loops are Master Pneumatic filters, in-line lubricators, Crown-Hannifin regulators and traps. Globe and gate valves complete the system, assuring that air reaching each machine and pneumatic tool will be as clean as possible, as free from moisture as desired, and of the correct pressure for top tool power. In this way the plant maintains its efficiency and each worker knows that he will have a fair opportunity to work on piece-rate jobs without needless interference from a faulty air system.

The Manufacturing System

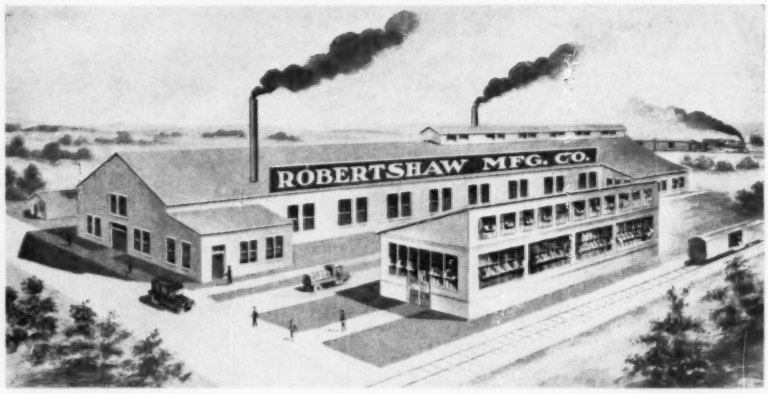
Returning to the manufacturing floor, the visitor sees clear spans of 20 × 100 feet provided for machine areas. The facility is 740 × 300 feet in size, divided into three bays for both manufacturing and customer repair service work. Aisles, 8 feet wide, look spacious but, more important, give plenty of room for movement of tote boxes. To help in this task are five Buda trucks and seven high-lifts, all radio dispatched and directed. All are LPG-driven. Provisions were made in planning the factory area for a 50-percent increase in output without additional building construction. Space surrounding the plant, however, will allow for another 50-percent expansion should such be needed. If so, probably an additional air loop would be installed; the location of the compressor house would remain the same.

Materials enter from a 20-foot-wide dock at the rear of the factory. All incoming material is inspected as the initial step in Robertshaw Thermostat's quality control program. Not having top-quality material with which to work can only lead to an inferior product—something that Robertshaw has never tolerated. The materials flow counterclockwise in a U-shaped direction during fabrication, and are shipped from the rear docking area. In the center are parts storage bins and tool rooms for easy access. Throughout the manufacturing process, thermostatic controls are spot checked; before shipping, every one is given a final inspection to assure that it is of a premium quality.

Looking up, the visitor sees the loop utilities systems. Above it is a roof of structural steel trusses, topped with aluminum decking and insulated with asphalt and gravel. Strategically spaced are plastic fire domes—looking much like skylights—that will burst should the temperature inside rise above a certain point. This is in keeping with contemporary theories of centralizing a fire for best fighting results. Additional fire protection is provided by local authorities and by the company's own 250,000-gallon water reservoir.



NEW AND OLD The aerial view is to the west; the Pennsylvania Turnpike runs to the right. The main entrance is immediately in front of the visitor's parking circle (center, right). Further right is the reflecting lake. The main manufacturing area is covered by the large rectangular roof. The other view is of the first plant at Youngwood, built in 1914.



In the manufacturing section, domestic controls for gas ranges, gas driers and other gas-operated appliances are made. Among these is the famous "burner-with-a-brain," the Flame Set. Developed by Robertshaw engineers to give the cook centralized and controlled heat whether the cooking pan is full or nearly empty, this control was named by the American Gas Association.

Besides the Flame Set, the other "bread-and-butter" product is Flame Master, an automatic oven control with low-temperature settings. With it, food can be baked, then kept warm without continued baking; plates can be warmed; and frozen foods can be quickly thawed. In short, it is another aid to housekeeping relieving the hostess for other duties or recreations. Flame Master has broken the former low-controlled-temperature barrier of 250° F with controlled heat at 140° F.

Many other controls and variations are constructed here for industrial, farm and commercial use. Their wide-spread familiarity seems to bear out the company's slogan: "Robertshaw—the name that MEANS controls."

Corporate History

Where did this synonym for Robertshaw develop? Looking at photographs hanging about the main office and lobby, and traveling back in time, the visitor gains an insight into the background of this company. Corporate headquarters are in Richmond, Va. But they were not always there. At one time they were in Greensburg, Pa.

It all started in 1899 when a brass plant manager named Frederick W. Robertshaw developed a thermostatic control for his own hot water heater. News of its efficiency spread and so did the demand. Too keep pace, Robertshaw began manufacturing similar controls, starting a firm called House Service Utilities Manufacturing Company. The year was 1907. Sales mounted. Not long thereafter, the Robertshaw Thermostat Company was organized and a plant site was chosen in Youngwood, Pa.

Meanwhile, Weston M. Fulton, a meteorologist in Tennessee, experimented with a mechanism to measure atmospheric pressure. Since his device was sensitive to both temperature and pressure, he successfully applied it to a furnace as an automatic damper. Trade-named Sylphon, the control was marketed by The Fulton Company, renamed in 1926 the Fulton Sylphon Company to take advantage of the popularity the trade-name enjoyed.

In 1936, Robertshaw Thermostat Company became associated with Grayson Heat Controls, Ltd., a Lynwood, Calif., manufactory that had weathered the depression under the able leadership of John Grayson to become one of the largest West Coast producers of gas appliance controls. Later the American

Thermostat Company, St. Louis, Mo., came into the fold, followed by mergers with Bridgeport Thermostat Company of Connecticut and the Fulton Sylphon Company in 1947.

By now the product line embraced more than 100 different devices, and there were five manufacturing divisions. Corporate headquarters was moved to Richmond in 1957. Today, besides the headquarters and the Youngwood plant, there are research and/or manufacturing facilities in Long Beach and Anaheim, Calif.; Knoxville, Tenn.; Milford, Conn.; Columbus and Hillsboro, Ohio; Indiana and King of Prussia, Pa.; and Goshen, Ind. International subsidiaries and/or affiliates can be found in such widespread areas as Canada and Australia, and some of the countries in between—West Germany, Brazil, Mexico, Italy and France.

Sales are good. The 1959 figures reached $79,494,038—an increase of $50,000,000 since the last major mergers. It is understandable why Thomas J. Arden, Robertshaw-Fulton Controls Company's 55-year-old president, has backed the facilities modernization and expansion program, which, incidently, amounts to a healthy $27,000,000. The new Robertshaw Thermostat Division's plant alone brings the company's total manufacturing capacity to more than $110,000,000 annually.

Waste Disposal

Moving out of the lobby, the visitor quickly returns to the present, for it is not easy to overlook the 100 × 62-foot reflecting lake. The pool serves as more than a landscaped architectural compliment; it is an integral part of a $150,000 waste-disposal system. The treatment plant, integrated with the manufacturing facility, is the second of its kind in Pennsylvania, the other being at the company's Indiana Division.

"To preserve and improve the purity of the waters of the Commonwealth for the protection of public health, animal and aquatic life and for industrial consumption, and recreation . . ." is the way Pennsylvania worded its Administrative Code of 1929 (amended in 1937 and 1945). The very letter of this Code is followed in Robertshaw's treatment of waste.

All noncontaminated process water, such as compressor cooling water, is discharged through storm sewers directly into the company-owned lake, which has a 232,000-gallon capacity. Ultimate overflow goes into Jacks Run, a tributary of Sewickley Creek and the Youghiogheny River.

Effluent emanating from the waste-treatment plant, estimated at 75 gpm, is also channeled through a storm sewer line to the lake where it is subsequently diluted with the noncontaminated process waters and other storm run-off.

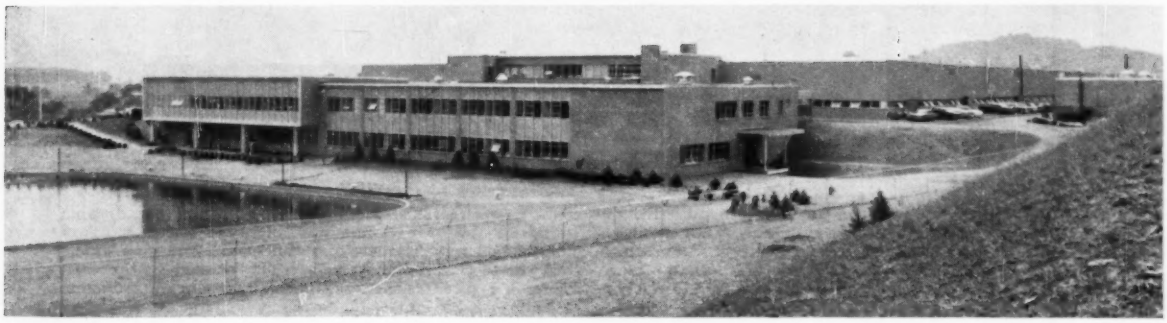
The treatment plant itself utilizes an acid-alkali neutralization, coupled with a complete cyanide destruction system. Acids handled are those produced by the plant's plating and finishing operations and include nitric, hydrochloric, sulphuric, phosphoric and acetic. Pickle, deoxidizing and bright-up solutions are also processed. Two 15,000-gallon tanks handle the acid-alkali neutralization, while three similar ones take care of cyanide. Acids are dumped every 60 operating days, or every 960 active hours; alkalis, every 20 operating days or 320 active hours.

There is also a dual filter system for suspended solids. Of the pressure type, it removes all solids before they go into the receiving stream. Metal hydrates, now nontoxic, are collected from the filter leaves and dumped when necessary.

Industrial wastes produced from the plating process are channeled through a separate sewer system within the plant to separate collection sump basins in the waste-treatment plant. These wastes are processed to produce effluent discharge allowable by regulations of the state sanitary water board.

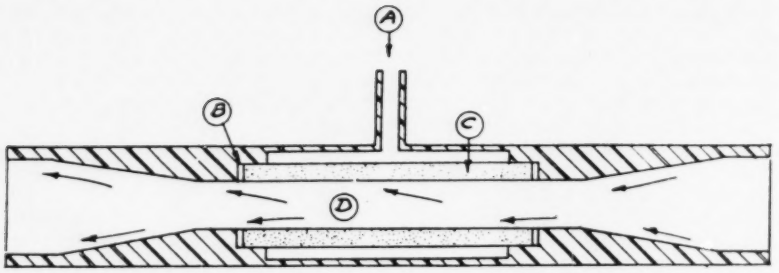
A further separate system is used to discharge sewage into the Hempfield Township sanitary sewer system. Another drain line discharges oil waste into the main collection station where it is dumped and sold to local township authorities for use on roads.

Having toured this modern factory and looked at its construction, utilities and waste program—and noting that there are no dead fish on the surface of the pond, a clear indication the treatment system is functioning properly—the motorist can return to the turnpike in a few minutes, aware that the aims of the company, as executed by designers and contractors, have been met in this practical, efficient plant. The 28 miles to Pittsburgh's Golden Triangle tick off rapidly.



WASTE TREATMENT Two parts of the $150,000 waste-disposal system are shown here—at right, some of the holding tanks; below, the reflecting lake. Toxic waste is handled via a combined alkali-acid neutralization system in concert with a complete cyanide destruction set-up. Pressure filtration removes all solids. Noncontaminated process waters and effluent emanating from the waste-treatment plant are channeled into the lake. The view of the plant is from the west, showing the cafeteria (center, highest elevation), foremen's parking lot (right) and the maintenance building.

A Centrifugal Pump Circulates Air-Water Mixture, Breaking the Rules in —



VENTURI SECTION The venturi action of higher velocities, plus an accompanying pressure drop in the restricted area, is used to introduce air into the system. Lower internal pressure (about 1 inch Hg of vacuum) draws air through the porous stone tube (Fig. C). Liquid flowing through the tube wipes the tiny air bubbles from the core surface before they can grow. Figure A is the air inlet, B is the gasket, and the section marked D is the reduced pressure zone.

Industrial Waste Purification

A BASIC RULE for a liquid moving system using a centrifugal pump is to have an airtight suction. Centrifugal pumps are not designed to operate on an air-water mixture and such operation can lead to all sorts of trouble—loss of prime, accelerated erosion-corrosion, reduced capacity, and rough operation with such subsequent mechanical troubles as shaft breakage.

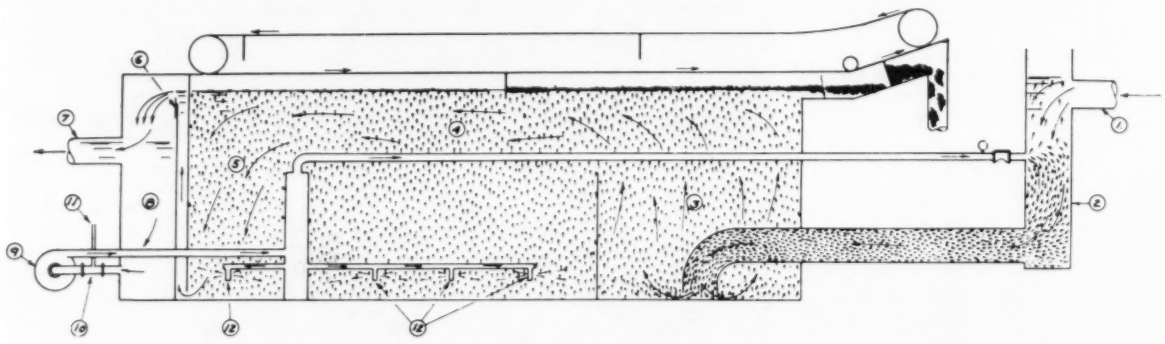
Although fully aware of this, the designers of the Gibbs flotation system, illustrated here, for industrial waste purification take a great deal of pains to introduce as much as 2 cfm of air into an Ingersoll-Rand RVNL Motorpump recirculating 400 gpm. The engineers don't even bother to use a special pump; theirs is one of a standard line of single-stage close-coupled centrifugal Motorpumps.

This practice of discarding accepted procedures is not new in the Gibbs unit, manufactured by Komline-Sanderson Engineering Corporation, as the entire system for liquid clarification works on an exactly reverse principle to the more conventional settling processes. To clarify liquids by settling, the suspended particles must have a specific gravity greater than that of the liquid. Depending on the ratios of the gravities, a considerable time element of liquid retention is necessary. In flotation, the ratios of the gravities are reversed by means of tiny air bubbles. These attach themselves to the suspended particles, causing the particles to rise rapidly to the liquid surface where they are skimmed off.

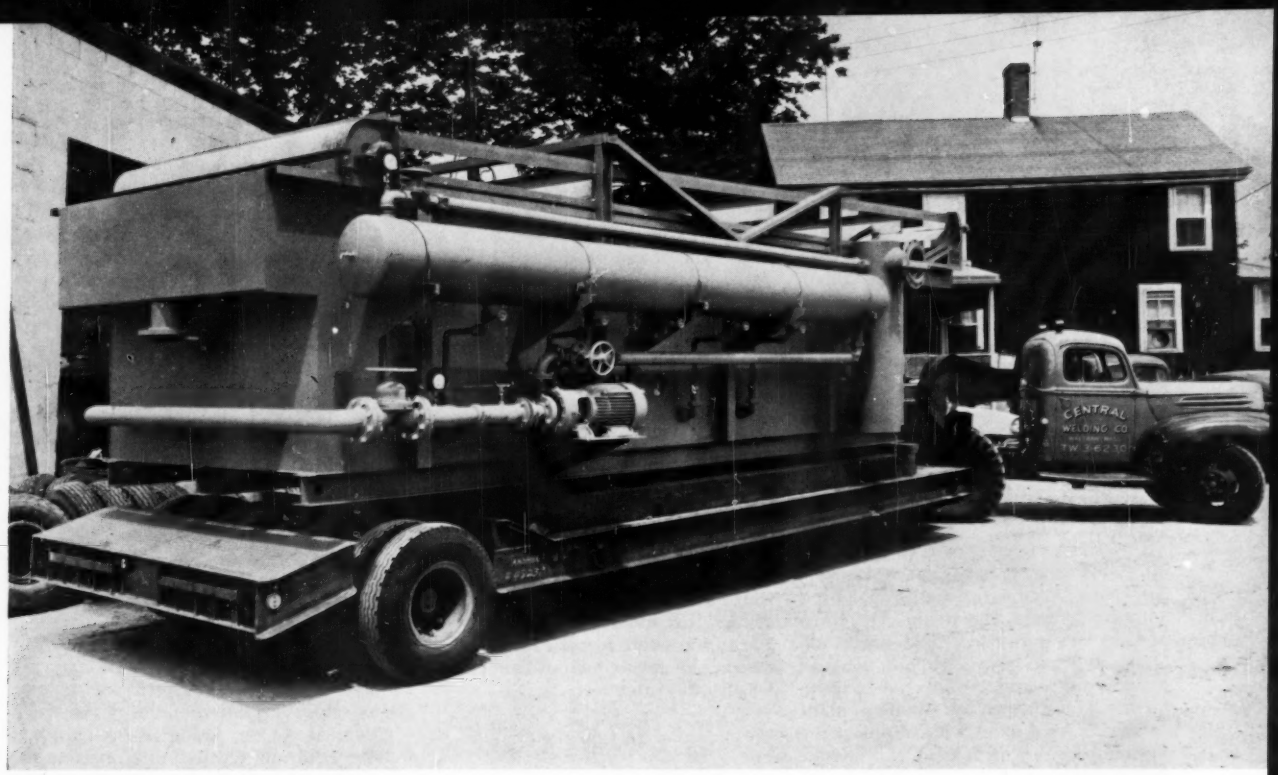
In many industrial wastes, especially involving soluble oils, grease, fatty acids, soaps, suspended fines, etc., particles settle very slowly or persist in remaining in suspension indefinitely. Most of these suspensions or emulsions can be floated with the air bubble system. In the Gibbs unit, the bubbles are generated without the aid of a compressor. A venturi section is provided immediately in front of the pump intake. The throat of the venturi (*drawing above*) is formed by a porous artificial stone tube with a $^{3}/_{8}$-inch wall thickness. The air intake is open to atmosphere, restricted only by a needle valve to permit reduction in the volume of air if desired.

A heavy-walled, low-porosity tube provides millions of minute holes through which air can pass into the suction flow. The velocity of the liquid flow through this section wipes the tiny air bubbles from the tube's inner surface as soon as they form, preventing agglomeration.

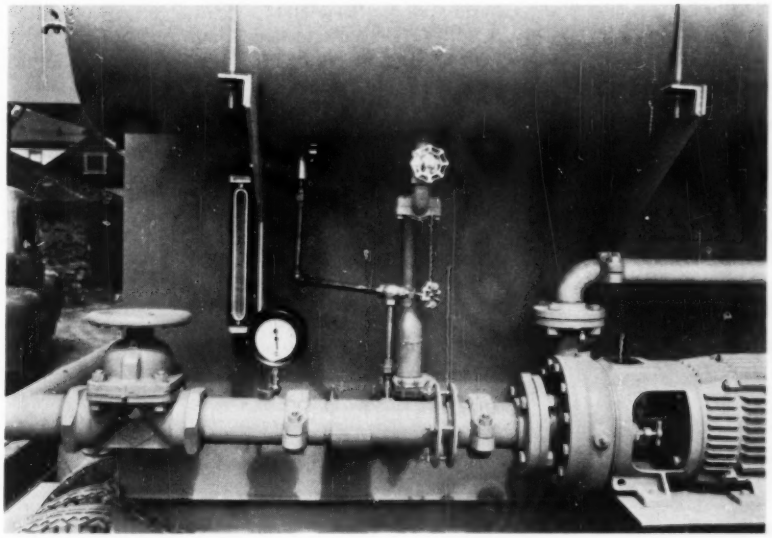
The bore of the diffusion section is less than the suction piping diameter producing the venturi conditions of increased velocity and reduced pressure in the throat. The pressure differential between the atmosphere and the reduced pressure at the throat causes air flow into the system and the creation of volumes of extremely small air bubbles.



FLOTATION UNIT Suspended particles are subjected to impingement of the air bubbles three times between the inlet (Fig. 1) and the outlet (Fig. 7) of the Gibbs flotation unit. The air-water mixture circulated by the Ingersoll-Rand Motorpump (Fig. 9) is discharged into the liquid at the inlet riser (Fig. 2) and in the lateral (Fig. 4) and counterflow (Fig. 5) zones. The treatment produces clarified water (Fig. 8) from industrial waste with a minimum of liquid retention. Flow rates of 3-4 gpm per square foot of floor space are standard in these waste clarification systems. The parallel flow zone is Figure 3; Figure 6 is the discharge weir; 10, the air induction assembly; 11, air intake; 12, air-water discharge.



CLARIFICATION SYSTEM (Above) Compact design permits factory assembly and testing of the entire unit. After being set on its foundation, the only connections necessary are intake and discharge, and electricity. Gibbs flotation units are made in seven sizes to handle fluids at 50 to 1250 gpm.



EASY CONTROL (Right) No air relief valves or complicated control valves are used in the system. An air flow indicator and needle valve are provided to reduce the air flow into the Ingersoll-Rand centrifugal Motorpump if desired. Despite the rigorous conditions, the Gibbs unit uses standard Motorpumps.

The single-stage Motorpump discharges the air-water mixture into a distributing tank that separates any agglomerated air bubbles. (Only bubbles of optimum size are introduced into the waste fluid.) Flotation of suspended particles is accomplished in three distinct flow zones—parallel, lateral and counterflow—as shown in the other drawing. The air-water mixture is introduced into the inlet for raw waste liquid. As the liquid enters the flotation unit, air bubbles move upward, parallel to, but faster than, the liquid. The majority of material removal is in this zone.

As the liquid moves toward the outlet, more air-water mixture is introduced all along the bottom of the unit. The bubbles rise to the surface, moving at right angles to the liquid flow through the unit. The last treatment is at the outlet where the liquid flow is directly counter to the rising bubbles.

In addition to removing suspended materials with this extensive air baffling, the air bubbles provide oxidizing purification to remove taste and odors. Flotation provides excellent clarification whether the raw water is cold or warm. The unit discharge is usually suitable for disposal or reuse.

Approximately 40 percent of the designed maximum flow is recirculated to produce and distribute the volume of infinitesimal air bubbles to the unit inlet and the outlets throughout the unit. Variations in the flow rate through the flotation unit have no effect on the air induction recirculation.

The amount of air flow is controlled by increasing or decreasing the head on the pump, thereby correspondingly altering the inlet flow. The pump inlet flow, being drawn through the venturi section, varies the amount of air intake. Pressure in the venturi drops to approximately 1 inch Hg of vacuum. The entire air induction assembly and recirculation of the air-charged clarification water requires no air relief valves or complicated controls. The clarified water zone provides the recirculation pump with a constant flooded suction.

This and That

Helium Extraction Plant

Construction of the first privately financed helium extraction plant in the U. S. to supply the commercial market is beginning in Pinta Field, Apache County, Ariz. Air Products, Inc., is designing and engineering the plant for Kerr-McGee Oil Industries, Oklahoma City, Okla., and will provide all of the low-temperature crude extraction equipment. (This is the second helium plant for which Air Products has supplied the low-temperature equipment, the first being the Bureau of Mines facility, Keyes, Okla., which went into operation in 1959.) At the Pinta Dome it will remove helium-rich product from the crude gas stream. Extraction is accomplished by cooling the feed gas with liquid nitrogen to -300° F, at which temperature most other components in the stream are liquefied and separated from the helium. Rich-helium from this process is then delivered to the final purification section of the plant where the remaining impurities are removed by absorption. The nitrogen-helium gas which will be processed from the Pinta Field contains about 8 percent helium. The plant will be capable of processing 2,500,000 cubic feet of gas per day and will produce Grade "A" product 99.995 percent pure. Kerr-McGee engineers calculate that the Pinta Field has recoverable reserves of 7.5 billion cubic feet. The recoverable reserves of pure helium are therefore 600,000,000 cubic feet.

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New Light On Desalting Water

According to George Karnofsky, at a symposium on saline water conversion, fresh water can be produced from salt water by freezing it with ordinary butane cooking gas. The cost is only $0.19 per 1000 gallons, which includes both power and chemicals. Butane is used as a refrigerant and melting agent in the process. A pilot plant for further studies is being built. Preliminary estimates indicate that a plant with a 10,000,000-gallon daily capacity can be built for $20,000,000.

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The Crowded Marina

The skipper of a "boat" displayed at the recent National Motor Boat Show in New York will have to be uniquely qualified. Evinrude designers in Milwaukee, Wis., combined an outboard runabout with a helicopter and came up with a sports craft they call the Heli-Bout. It is a 16-foot boat mounting a 76-hp Evinrude Stafflite outboard motor. Overhead is a rotor linked to the engine by flexible shafting and reduction gears. Passengers board by way of a sliding plastic canopy similar to those of today's 2-place personal aircraft or helicopters. Cockpit instruments are similar though not so complete as those on a plane or helicopter. The boat (aircraft) has dual controls for throttle, clutch and stabilizers. Steering controls can be transferred from skipper to skipper (pilot to pilot). The Heli-Bout is not yet available to sportsmen but Evinrude foresees that one day the rotor craft will flit fishermen from lake to lake and eliminate driving from one to another. Other uses could be for law enforcement, search and rescue operations, surveying work and aerial photography. The captain of this will, of course, have to know something about flying a helicopter as well as the rules of the road on water. He will also have to keep a weather eye alerted for an occasional pond or backyard swimming pool should he have to make a forced docking.

THE chap adjusting the valve wears an outfit that can protect him while handling toxic missile fuels. One day it might also go to the moon to serve as a portable atmosphere for a space traveler.

Inside the suit, on the wearer's back, is a "life-support" system designed by the AiResearch Manufacturing Company of Garrett Corporation, Los Angeles, Calif. It consists of these things: a cylindrical cryogenic air storage vessel that supplies breathing air, a quantity gauge, an ejector for circulating the air, a heat exchanger for cooling the recirculated air and a trap for collecting solids and entrained water.

The unit provides a completely self-sustained, habitable atmosphere with controlled ventilation and humidity. Sufficient liquid air is carried to support one man for 2 hours before recharging.

Here's how it works. Warm air returning from the suit is passed through a finned heat exchanger. This heat vaporizes and warms the liquid air feeding into the system as make-up from the storage vessel. The cold (—180° F) make-up air at 150 psig then passes through an ejector. The ejector supplies pressure to maintain flow through the suit, heat exchanger, water trap, valves and lines. The ejector make-up air mingles with the circulating return air, then returns to the ventilation distributor of the suit, after passing through the heat exchanger and water separator.

Garrett has recently introduced a version designed specifically for space wear. The Moon Pack suit would take care of a man under conditions found on the moon or as probably will exist on a space platform. The rig illustrated here can be used for many jobs away from the missile pads.

Other applications include working near poisonous fumes found in chemical plants, fire fighting and rescue work, mining, nuclear installations and other places where man needs a safe atmosphere.

The back pack life support system, shown in the inset, weighs 17 pounds. The suit and the pack together weigh 50 pounds (on earth).

Nails, Shells And Soap

Twenty air cylinders with solenoid-valve control operate this prototype packaging machine that forms a strong corrugated box from a single blank. Originally designed for packaging nails, the machine is receiving further development so that it can be used to box materials ranging from shot-

gun shells to detergents. The New Products Division of Mead Corporation, Cincinnati, Ohio, says that in addition to use in the air cylinders, compressed air also sprays on a water-based adhesive in a precise pattern for assembling the boxes. The containers emerge from the packaging unit with three plies on the bottom and two on each side. This gives an exceptional top-to-bottom strength: a loaded box in a stack can hold a weight of 2200 pounds.

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Most Valuable Gas

Here are a few interesting facts about air.

Every 24 hours you breathe 6000 gallons of it. From this your lungs harvest 1200 gallons of oxygen.

Though air has no taste of its own, it changes the taste of other things. There is a legend that says tea-drinking started when water was boiled for sanitary reasons. It was flat with the air bubbles chased out. Tea leaves soaked in the boiled water gave it an acceptable flavor.

You can't see air but can watch what it does and what it carries. Once a tornado heaved a church steeple 15 miles. Violent winds have spewed fish over seacoast villages.

Air delights in creating optical illusions. Desert travelers see lakes that are only pools of hot air. Arctic sunlight on a ship has been mirrored in a cloud of warm air overhead. Sailors saw their ship hanging upside down from the sky.

Close to the earth, air is heavy with water vapor and dust particles. Red sunsets and blue skies are partially air's handiwork. The airborne vapor and dust reflect and refract the light. The result is a brilliant sweep of color. But miles up, where the particles don't reach, space is black.

In outer space, air assumes a paternal protective role. Absorbing the more violent rays of the sun, it shields the earth from intense heat and radiation. Chunks of planetary rock hurtling earthward burn up from friction with air.

Though it defends men against astral enemies, air is often less friendly on the earth's surface. It exerts about 2000 pounds of pressure on every square foot of a human's body. (Luckily the force is equal on all sides.) Air carries unpleasant odors, floating dirt and dust, as well as organisms that threaten health.

When persons talk about fresh air, they usually mean outdoors air. This isn't necessarily cooler, cleaner or healthier than the air inside your home or office. Sometimes it's far worse.

If you live in a city, you inhale about $1^1/_2$ pounds of dirt each year. It comes from automobile fumes, factory smoke and soot, industrial waste gases and dust from construction work. It has been estimated that in the U. S. about $250 million is spent annually combatting air pollution. But in many places man is losing the battle, mostly because of his own contraptions. (In Los Angeles, Calif., smog reportedly could be cut in half tomorrow if all cars stopped running.)

To avoid air pollution, you could move to a small town in a sparsely populated area, or perhaps a mountain top. Theoretically the best solution would be to set up housekeeping in the middle of the ocean—the location of the purest air in the world. But your ship's fuel, cooking odors and your own cigarette smoke and carbon dioxide would spoil the bright sea air.

Air is a workhorse, a life-giver, a protector, a threat, and a magician. It is one of the most fascinating materials in the world, and perhaps one of the least appreciated.

WHEN a new school addition was going up near Baltimore, Md., a large section of old concrete walk and a paved driveway had to be torn out to make way for a new play area. The students had a first-hand view and, thanks to an alert schoolmarm, a new experience with compressed air. Miss Ruth Stroh, a second grade teacher, watched the eager-eyed, inquisitive, curious youngsters, and turned air power into a teaching aid.

The pupils observed the pneumatic paving brakers and portable compressors at work on their playground. They watched the men with admiring glances, and even at their age, the teacher says, they were eager to discuss "the meaning of compressed air—how it saves time, money and manpower."

Some simple science experiments were held, and the worker who had been using the paving braker gave a talk to the class about his tools and techniques for operating them safely. This was followed with a film showing pneumatic tools at work, a visit to a nearby streetcar line repair job, modeling small clay drills and drawing pictures of the men at work on the proposed play area. One of these drawings is reproduced below. We take our hat off to Gary, age $7^1/_2$.

Computer Course Announced

Managerial and technical personnel in the mineral industries may take advantage of a short course concerned with computers and computer applications. It will be given April 4–7. The purpose is to familiarize people in responsible positions in the industry with the relatively new and rapidly expanding field of high-speed data processing. The course treats computers and peripheral equipment, introduction to computer programming, mathematical techniques, and feasibility of computer utilization—all with special emphasis directed to the mineral industries. Applications will be accepted until March 1 by Professor E. R. Drevdahl, College of Mines, The University of Arizona, Tucson, Ariz. They should be made by letter, giving the participant's name, company affiliation and occupation, together with the course fee of $100 which does not include the cost of the student's meals or lodging.

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Another Aid To Education

Hardly a day passes when we do not hear of the ever-rising cost of higher education, of the urgent need for trained specialists, of the over-crowded conditions in the universities. It is therefore reassuring to learn of any program that helps to eliminate even one of these problems, and the American Society for Metals is working on the first two conditions. The ASM Foundation for Education & Research was established in 1953 to recognize outstanding achievement in the study of metallurgical engineering, and to encourage more students to enter this important profession. The $750,000 Foundation is the largest ever established by a technical society from its own resources. It is offering $30,500 in college scholarships to student metals engineers. Equal awards of $500 will be given in 1961 to metallurgical students at 61 participating colleges and universities throughout the U. S. and Canada. Winners are chosen by the schools themselves and receive a certificate in addition to the cash award.

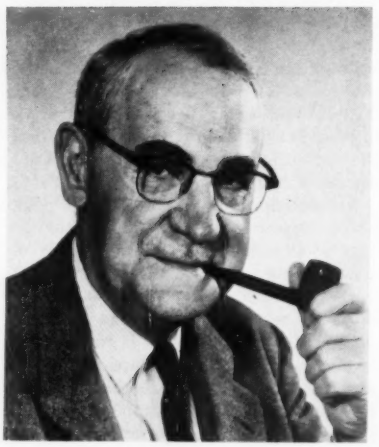
"Golden Beavers" Awarded to Four In Construction

Golden Beavers Awards for 1961 were awarded to four men for outstanding contributions to the heavy construction industry. The Beavers met January 19 in Los Angeles, Calif., for their Sixth Annual Meeting and Awards Dinner. Recipients of this year's honors were T. E. Connolly, for distinguished management; David E. Root, for achievement in supervision; George T. McCoy, for engineering achievement; and John L. Savage, for special honors. The Beavers group is an organization of the West's heavy engineering construction leaders. The citation for each of the awardees is included, in part, in the captions.

DAVID E. ROOT Retired Vice President of the vast Guy F. Atkinson Company and still a dynamic individual at the age of 73, he is a legend in his own time. In charge of all Atkinson's activities in Southern California until his retirement in November, he has consistently contributed to the stature of the profession.

T. E. CONNOLLY Head of the San Francisco contracting firm bearing his name, he is a Regent of the University of San Francisco. He has served his country, its people, its Armed Forces and his industry well and has set an enviable record for outstanding management.

JOHN L. SAVAGE Gold Medal winner of the U. S. Department of the Interior, this Denver, Colo., consulting engineer has specialized in dams and power plants for almost 60 years. Concrete and steel monuments to his ability harness hundreds of rivers the world over.



GEORGE T. McCOY During his 16-year tenure as Chief of the California Division of Highways, he revolutionized highway travel in the state. The honored engineer retired last autumn and received a resolution of praise from the State Senate and a number of national awards and recognitions.

EDITORIALS

About Avocations

PUNDITS say that all work and no play makes Jack a dull lad. They're right, of course, and most of us have our avocations and outside interests. As a matter of fact, the amount spent by Americans on recreation and hobbies totals a whopping multibillion dollar figure each year. It's big business carried on in a big way.

We were doing some daydreaming the other day about an ideal vacation (probably induced by subfreezing temperatures and the fact that a friend had just left for a warmer climate). These pleasant thoughts were still with us when the customary year's-start review of past issues was made. A couple of references in some of these set us speculating on the uses of compressed air in the businesses that serve our recreation requirements.

WITHOUT making any type of penetrating study of the field, it was still somewhat startling to find the ways in which compressed air is at work for us in this respect. Although some of our readers in northern climes will probably shake their heads a little, there are times and places where snow is eagerly sought, even to the point of making it when there isn't any. To the genuine ski buff, the worst of all possible worlds is one with a good ski slope, but no snow on it. Compressed air has been put to work in an apparatus that generates snow by atomizing water through special nozzles. There are a great many of these snow making machines throughout the country. Often the compressors are portable in the interest of putting them to work some place else during the three seasons when temperatures make it impossible to make snow. The economics of snow making are quite simple. Its cost is considerable, but still much less than the loss of revenue to be expected from a snowless slope during a big weekend of the skiing season. A great deal of other overhead such as lifts and lodge, etc., must be paid for during what is, to slope operators at any rate, an all-too-short season.

In addition to the unusual task of snow making, compressed air is at work in the clamps and presses required to produce the skis, particularly the laminate variety. Archery enthusiasts too, find air of aid, for bows are produced in much the same fashion.

TURNING from the mountains to the shore, compressed air, of course, has long been a necessary ingredient of waterwing-type swimming aids. Its biggest use is in scuba diving, one of the world's fastest growing participation sports. Indeed, businesses are founded on servicing the compressed air needs of these sportsmen and women. The spear guns and even the underwater propelling devices used by skin divers are also often compressed gas powered. And, for the bather that prefers to keep his head above water, we even noted in one issue a compressed air screen that was being tried out for keeping sharks away from beaches.

Boats are now frequently made by air spraying fiber glass and resins over a mold to form a vessel that is strong, lightweight and frequently less expensive than other models.

SHOOTING enthusiasts that like to carry on gunning practice all through the year frequently utilize air- or gas-powered rifles and hand guns for target shooting indoors in winter months. Some fans prefer gas guns throughout the year.

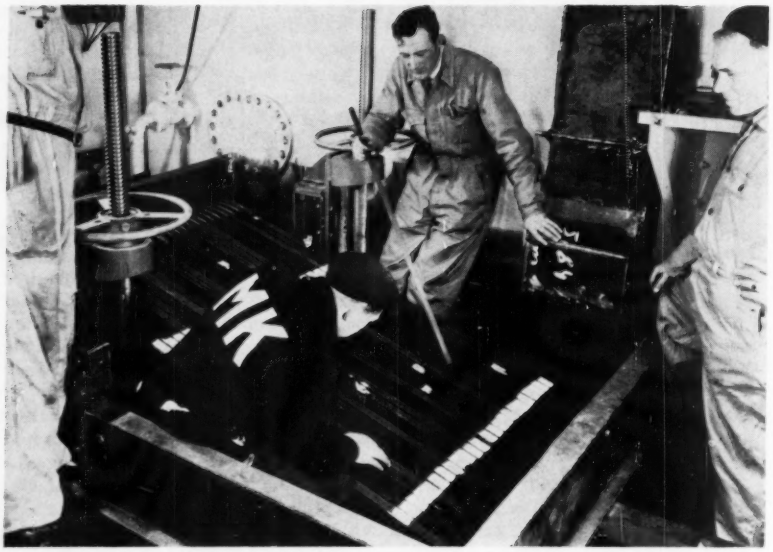
The second and third most popular spectator sports, football and basketball, require compressed air to inflate the chief item of playing apparatus. Even baseball, number one on the list, makes use of a little in machines that pitch batting practice.

THOSE of us preferring a more sedentary form of relaxation can also find some compressed air applications. Just last month we reviewed the role of compressed gases in creating movie and television special effects. And, in visiting our printer recently, we were amazed at the number and variety of vacuum and compressed air applications in the printing of magazines and books.

About Awards

EACH YEAR, during January, two organizations, the Moles on the East Coast, and the Beavers on the West Coast, honor members of the heavy construction industry for service to that industry. The signal honors that these awards represent are highly prized by the recipients. They, in turn, are most deserving of the recognition. There is another facet to these awards, however, that should be noted. In so honoring its leaders, the construction industry does great honor to itself. The news of the presentations does not go unnoticed outside the industry and the favorable impression made in the public eye is something that the firms and men in the industry can count on the plus side of the ledger. Its impact on young men about to choose a career is also considerable. It may be that the latter impression is what will make the groups self-perpetuating, for it is from the ranks of these young men that the honorees of years hence must come.

The Belts of an Icebreaker



MUCH has been said about keeping waterways free of ice by using air bubbles, but this is not to say that this has eliminated the job of the hardy icebreaker. *Herkules* has just such a responsibility. Commissioned by A/S Norsk Bjergningskompagni as an ocean tug and salvage vessel as well as an icebreaker, she carries four diesels capable of developing more than 4000 hp to meet the power requirements of her rugged tasks in Norwegian waters.

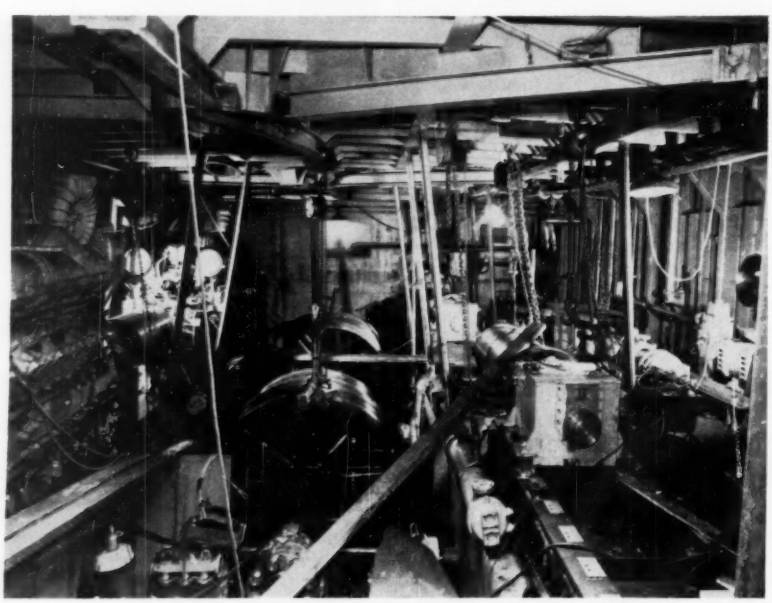
Power is transmitted to a single propeller through the world's largest V-belt installation. The power train uses 96 HY-T Goodyear vee belts in four matched sets of 24. (The picture at the top of the page shows Norwegian technicians adjusting one of the four sets.) Each of the 1100-hp motors drives 24 belts to the central shaft and its variable-pitch propeller.

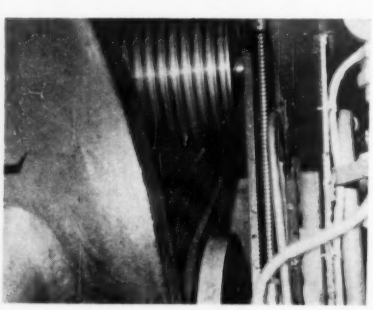
A clutch system permits any combination of the motors to drive the propeller. A central clutch can disconnect the forward pair of engines from those at the rear of the ship. Individual clutches on each engine can be disengaged to set the belt system free to be driven by just one engine. During the trial runs, the ship owners found that this arrangement permits a single engine to use the inertial mass of the 86-inch belt sheaves on the main shaft to advantage as a flywheel.

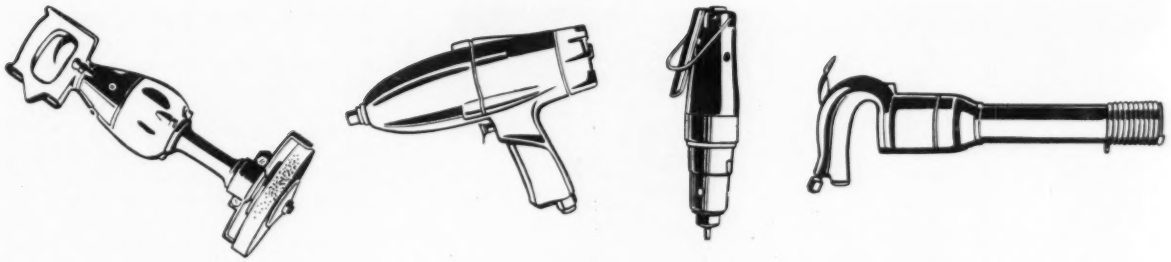
The V-belt drive was selected to absorb the shock of the propeller striking chunks of ice. It also eliminates the need for many replacement parts and, according to engineers of The Goodyear Tire & Rubber Company, reduces the weight of the ship's drive unit. This means *Herkules* has an additional 150-ton fuel oil capacity. The 420-inch-long, multiple-ply belts can absorb shocks that could destroy a geared reduction drive, and an extra set of coiled belts occupies only a small area compared with that required for spare parts for a geared unit.

A 3-to-1 reduction from motor speed to the 200-rpm (at full power) propeller shaft was established. Belts are strung on 28-inch sheaves at each motor and are tensioned over adjustable take-up rollers. A shaft and pulley arrangement was designed for easy changes of belts when necessary. The tension rollers are relaxed and the main shaft quickly disconnected to provide space for the endless belts to be slipped into place.

The photograph at the left is of the engine room half way through the installation of the V-belt drive unit. Two of the four diesel engines are in place, the last section of the main shaft sheave is being placed, and clutch units for two remaining motors are in position in the right portion of the picture. Below is a close-up of the major components of the V-belt power train. Belts are tensioned in a reverse curve over a flat take-up roller.







PERIODIC PREVENTIVE MAINTENANCE

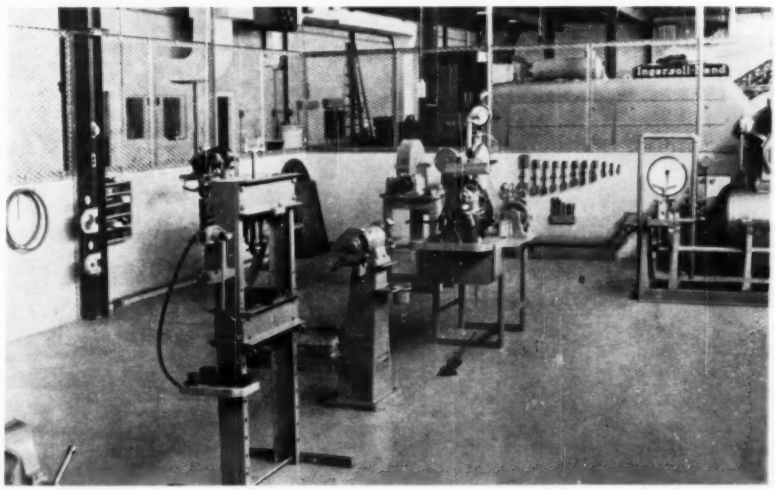
II. General Considerations—The Program

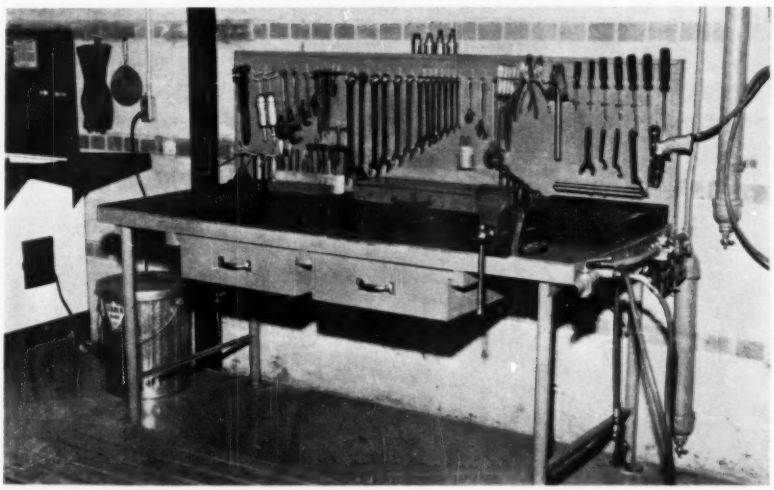
PREMATURE failure of air-operated tools is generally caused by any of six basic faults: (1) excess moisture in the tools; (2) foreign particles abrading internal parts; (3) removed strainers from inlet ports to the tools; (4) lack of proper lubrication; (5) manual abuse and misuse; and (6) failure to replace worn, inexpensive parts that can be discovered through programs of planned, periodic preventive maintenance. Of the six, the last is the most diverse and should receive the greatest consideration. All tools before they leave any reputable manufacturer are tested and must meet certain specified power standards. Lack of periodic maintenance results in decreased efficiency, progressive wearing of inexpensive parts and eventually, premature failure of the tool.

Quality tools are constructed so that they can be quickly broken down into their subassembly components, checked, lubricated and reassembled. Periodic examination of a tool usually requires only 6–12 minutes, not including time for replacing parts if necessary. Complete lubrication should be always done at this time.

All units must be inspected to see that they are securely fastened because air leaks and costly low power output would result from loose connections. Buffers and retainers on tools, expecially the percussive types, should be looked at and serviced if required. Usually all future maintenance on percussive equipment results from wear on these parts. The throttle mechanism must also be inspected with special attention given the major wear areas—levers, retainer pins, throttle valves and plunger parts. When worn, these lead to inefficiency, although not necessarily to destruction of the entire tool.

All parts should be replaced so long as the replacement cost does not exceed 40 percent of the original cost of the tool. When it does exceed 40 percent,





TYPICAL REPAIR DEPOT Shown at top is a typical arrangement of an Ingersoll-Rand factory service repair depot. Above is a bench setup showing the tool board in a repair depot. The other pictures in this article show methods for checking pneumatic tools after they have been repaired in a program of planned preventive maintenance. Such procedures are essential in properly maintaining tools and gaining maximum service from them.

the still servicable parts naturally have shortened life expectancy, and a new tool should be purchased. Because of the ever-increasing advances in engineering technology, the new tool will have, compared to the original one, a better than 100-percent power factor. Further, it will be quieter in operation and will be lighter in weight per horsepower output. It is wise to consult with your pneumatic tool sales-engineer to organize a program of planned annual retooling in addition to a program of periodic preventive maintenance to get the most from your compressed air dollars.

Replacing inexpensive parts can be done two ways. Either the tool can be returned to the manufacturer's repair facilities or repaired by the user.

AT LEFT (Top to bottom) A reed tachometer is used to check the speed of a chipping hammer on a chip plate, and its cutting ability is tested. A Skidmore-Wilhelm calibrator is used to test the Torsion Bar Torque Control setting of an Ingersoll-Rand Size 5340T Impactool. At the bottom is a photograph of a 1-inch brake being driven by an I-R Size 834 Impact Wrench to check the time per revolution.

BELOW (Left to right) To check the blows of a Size 341 Rammer, a clay box is used. In the center, an Ingersoll-Rand Size 4 Grinder is being tested on the large XM5 fan. Air flow is also gauged through a New Jersey Meter Company Tool-om-eter in the background. At right a 0.0003 Prony brake is helpful in verifying the horsepower of a Size 30 drill.

As an example of the first instance, one manufacturer has set up a system of repair depots located in its major branches throughout the United States and Canada. These are in major areas of tool use. Replacement parts for all tools are stocked at these depots, and there are facilities for repair work and testing. With its widespread organization, totaling 28 repair depots, this manufacturer assures its customers that no tool will be off the production line for very long. It is interesting to note that no tool that is returned to a user until its original power output is completely restored.

Some tool users prefer to stock certain replacement parts. These need not be extensive—a minimum stock list can be recommended by the tool sales-engineer. The required parts can be indicated directly on the manufacturer's parts lists at the time critical areas for periodic inspection are pointed out. All the items can be stocked at a minimum cost and stored in a minimum space. Such small parts would include bearings and planet gears for screwdrivers, small drills, motors and all impact wrenches. When worn, these can rapidly lead to expensive repair bills. Other items that might be stocked with profit would be bearings, bushings, throttle levers and valves. Most of these can be replaced on the spot when the tool is taken in for periodic inspection.

Every tool, whether it is new or a repaired one, should be tested and the power rating noted for future comparison. This file of ratings is handy when reordering tools, buying new models or checking tools that are being returned to the production line from maintenance shops. Testing equipment, whether in a tool manufacturer's repair depot, as illustrated in this article, or at the user's own facilities, should contain certain basic equipment. For testing drills, for example, a Prony brake, scales, revolution counters, an air pressure regulator valve, a small air receiver and an air meter are essentials. Percussion tools are judged by air consumption plus the "feel" of the operator. A vibrating reed tachometer is handy to determine the blows per minute. Chipping tools are tested by cutting metal; diggers and paving breakers, by lead penetration.

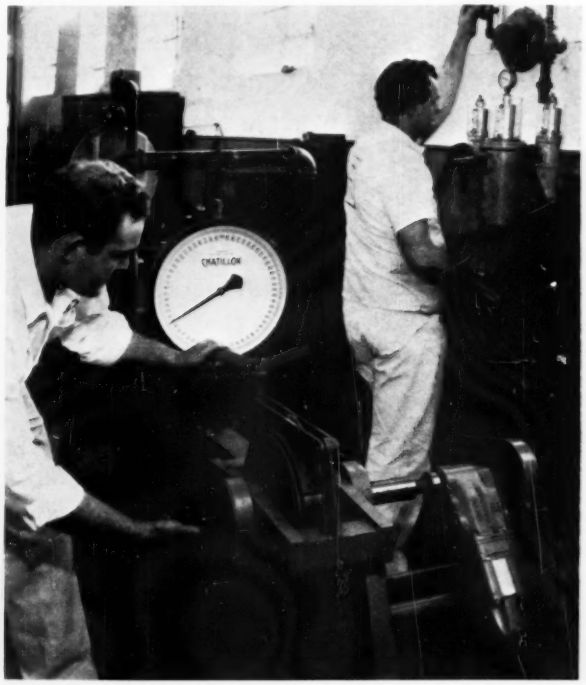
Determining the power output of pneumatic tools is a problem complicated by many variables. A program must be developed that will make accurate verification of output possible. One such system was developed by Skidmore-Wilhelm Mfg. Co., Cleveland, Ohio. With it, a new tool can be checked by comparing it with another of the same model. Tools already in use can be compared in carrying out preventive maintenance programs; output can be checked after maintenance work has been completed. The entire system is based on gauge readings, or norms. Data are given for pre-operation checking, the procedure to follow in establishing the power tool norm, and the method to follow in verifying the air tool power output. The results can be easily tabulated on special forms that are of value when reordering tools.

Preventive maintenance must be planned to be effective. All tools must be checked regularly by competent personnel. Technical knowledge, experience and "horse sense" are essentials for maintenance men. And some sort of system must be instituted and followed through to see that all tools receive not only regularly, but complete servicing. Possibly a card system—with one card for each tool—could be of value. With time, such a card index would become a history of the performance of each tool and the work that was required to maintain its efficiency. From these data, needed inexpensive replacement parts for future stock could be determined, and an economical over-all program of planned annual tool renewal could be organized as a result.

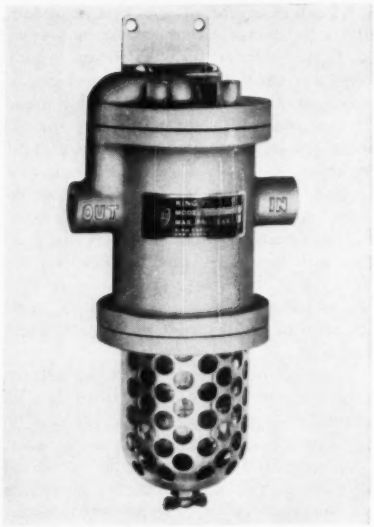
Other systems can be adapted from the military. Co-operation between pneumatic tool users is of inestimable value. Not to be overlooked are plant engineering handbooks that usually devote space to the problem of preventive maintenance and the planning of maintenance programs.

The word *planning* cannot be stressed too much. Haphazard systems are of little value; controls must be imposed on the program of preventive maintenance and tool renewal just as they are in accounting, time study and stock and records departments. Tools and compressors are only a means to an end. The real goals of a planned preventive maintenance program are to increase efficiency and cut costs.

—*S.M.P.*



Industrial Notes

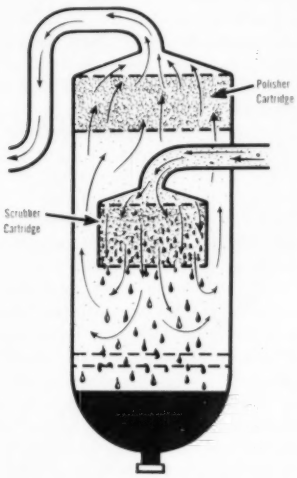


SCRUB-AND-POLISH is the operating principle of the King air filter illustrated at right. The filters are said to remove nearly 100 percent of entrained dirt, oil and water from air and normally operate many months without maintenance. Maximum flow rates range from 20–200 cfm, and pipe sizes go from $^1/_4$ inch to 2 inches. Air, on entering the filter, flows downward through a wet filter bed in a scrubber cartridge (*see diagram*). This thoroughly cleans the air of dust and dirt particles as small as 2 microns or less. In addition, mist and fog particles of oil and water coalesce and combine into larger drops as they pass through the wet filter bed. At the bottom of the cartridge, the liquid particles have been removed from the air and formed into large drops, as shown. These drops are too heavy to float in the air stream. Aided by the downward flow of air, they fall into a sump at the bottom.

The scrubber cartridge is saturated with liquid at the factory to start the coalescing action, and its operation depends on its being saturated. Thus this cartridge is not replaced when wet with oil and water removed from the air, but keeps right on filtering. The downflow of air continuously sweeps it clear of excess liquids. If loaded with gummy or resinous deposits, the cartridge may become clogged; but under all normal operating conditions, it works at full efficiency for many months without attention.

When the air leaves this scrubber, it reverses direction, passing upward and out through a dry-bed polisher cartridge at the top of the filter. The polisher cartridge removes practically the last remaining traces of water and oil, leaving the air quite clean. Since the scrubber cartridge does a reported 98 percent of the cleaning, the polisher also lasts for many months. However, both cartridges are disposable. Replacement of exhausted cartridges restores original

filter performance. Their small size and sturdy construction make it practical to keep ample spare cartridges in stock—one standard size fits all King filters.



Full details are given in Catalog 6000, available upon request. *King Engineering Corporation*, P. O. Box 735, Ann Arbor, Mich.

CONTROLLED WATER—what does it mean? In many cases it is related to reduced damage from flood waters, adequate stock and irrigation water in time of drought, increased agricultural profits and more complete utilization of recreational potential. All these and many other benefits result from the application of a planned water control practice on both large and small watersheds. What is being done and can be done to assure that the maximum benefits can be realized from water control in all parts of the U. S. is told in an 8-page booklet, *Controlled Water Works for You* (Form No. D039). Copies are available without charge. *Caterpillar Tractor Co.*, Advertising Division, Peoria, Ill.

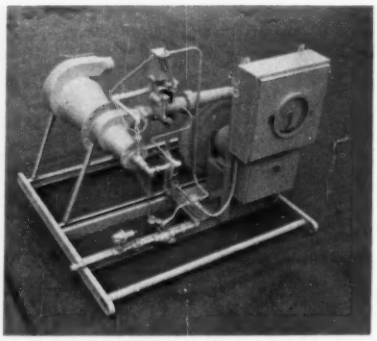
STEAM and water service is the subject of an engineering manual that is intended chiefly as a guide in the selection of automatic heating and cooling controls. It is designed with typical examples, offering workable systems to solve certain control problems, without limiting the reader's choice of mechanical equipment. A technical directory on the back of each of the 22 sheets lists additional literature available. Some of the applications covered in the manual are for domestic hot water, fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, process hot water, pressure reducing storage heaters, and 2-temperature hot water systems. Canadian readers may obtain free copies of this literature from The Powers Regulator Company of Canada, Ltd., 15 Torbarrie Road, Downsview, P. O., Toronto, Ont. Others may write directly to the American firm. *The Powers Regulator Company*, 3434 Oakton Street, Skokie, Ill.

ALIGNING pipe lines for welding is the job of the Model DJ Air Clamp, designed for pipes ranging from 20- through 36-inch diameter. The device has two heads that grasp the two pieces of pipe firmly and fit them together. The two heads operate on the center-of-line principle and can be used to line-up two joints of different wall thickness. Variations in pipe diameter are equalized around the pipe circumference. Rollers, according to the manufacturer, roll the lines into perfect roundness without friction or sliding on the pipe surface. Either steel or rubber rollers are available. All working parts on the machine are completely enclosed and made from high-quality aircraft steel to assure low maintenance. Equipped with its own 5-cubic-foot reserve tank, the unit can make several alignments without refilling. Bursting pressure of the tank is said to be a safe 400 pounds and recommended operating pressures for the device vary with the model, the lowest

pressure being 110 psig, the highest 175 psig. Four models are available, the smallest unit (for 20–22-inch pipe) weighing 412 pounds and the largest (for 34–36-inch pipe), 712 pounds. The other models, one for 24–26 inch pipe and the second for 30–32-inch, weigh 496 and 617 pounds respectively. Compressors of 8–10 cubic foot capacity are recommended for use with the pneumatic clamp. *Crutcher-Rolfs-Cummings, Inc.*, Box 2073, Houston 1, Tex.

Q-PAK, a packaged direct-fired air heater designed and manufactured by Black, Sivalls & Bryson, Inc., provides high combustion efficiency and absence of impurities. It has applications in many industries: basic uses include heating of process air for fluidized bed dryers or spray dryers; direct heating of furnaces, ovens, dryers or kilns; indirect heating of process fluids; multiheater temperature zone control on continuous dryers or kilns; packaged waste disposal units; and packaged multistage chemical reactors. Where especially high efficiencies and inert atmospheres are required, the Q-Pak may also be incorporated in flue gas recirculation heating systems, according to company officials.

Heart of the unit is the Uniflux Fuel Reactor—a high-intensity mixer in which combustion air is brought tangentially into an annular space around a combustion chamber. This produces a cooling



effect and enables the flue reactor to be constructed entirely of metal. The vortex created inside the reactor causes rapid recirculation and intimate mixing of the reacting combustibles and combustion air. This results in essentially complete combustion within the primary reactor. The inert products of combustion leave the primary reactor at flame temperatures and at velocities of about 500 feet per second. The hot gases then flow into the secondary reactor where they mix with the air or gas to be heated in much the same manner as the fuel and combustion air were mixed in the primary reactor. The result is clean heated air with no harmful carbon residues or combustibles such as aldehydes or carbon

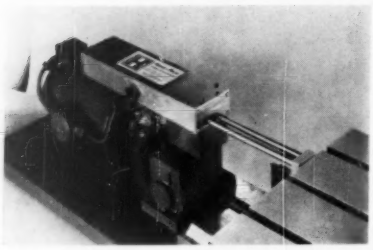
monoxide. Accurate, controllable proportioning of fuel and combustion air insures correct supply ratio to the fuel reactor at all firing rates.

Controls are simple because the fuel reactor has stability through a wide range of air-to-fuel ratios—from 50-percent stoichiometric to 100 times theoretical air requirements without loss of flame. The flame is contained in the reactor because of heat release rates to 10,000,000 Btu per hour per cubic foot of combustion volume. However, there is little measurable heat loss in the non-insulated chamber. (This can be experienced by placing the hand directly on the outer shell with heated air outlet temperatures as high as 3000° F.) The absence of refractory lining permits immediate response to changing temperature requirements—up to 3000° F—and allows reaching the desired temperature within seconds after ignition.

At the present, Q-Pak is available in sizes ranging from 100,000- to 10,000,000-Btu-per-hour heat release. Each unit is ready for immediate operation—only fuel and electrical supply hook-ups are required. *Black Sivalls & Bryson, Inc.*, Product Information Department, 7500 E. Twelfth Street, Kansas City 26, Mo.

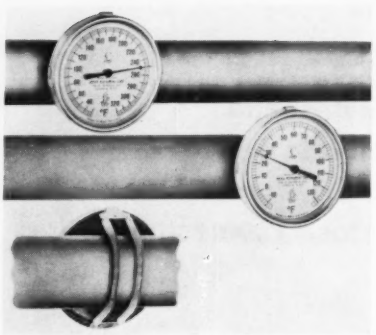
HANNA-POWR Positioner is used in conjunction with various types of power mechanisms such as air or hydraulic cylinders, along with solenoid valves applied to operate pipeline flow valves. It automatically positions machine tools (*see next page*) valves, float levels, doors, hopper gates and the like to any of several predetermined positions, corresponding to a control selector switch signal. The device has two cam rods, and a connecting link on one end is attached to the mechanism the positioner is controlling. The other two ends of the steel cam rods trip limit switches as the cam rods slide back and forth inside the two channel grooves in the extruded alumi-

num positioner housing. There may be as many as fourteen sets of limit switches per foot, thus fourteen different positioning stops per foot in the positioner. The positioner may be made in various lengths, up to 8 feet.



The servo action takes place as the end of the positioner cam rod moves or hunts for the position requested by the selector switch; it passes the various sets of switches until it trips one switch at the desired position. This servo action causes a solenoid valve on the power cylinder to move the cylinder in the opposite direction; thus the cam trips the other limit switch in the set, energizing the other solenoid of the valve to apply air or hydraulic energy to move the cylinder in the opposite direction. The cam rod then stops in the "null" band area between the set of switches, at the position requested by the positioner's control selector switch. (One of the limit switches in each pair is normally open, the other normally closed. The limit switches are not set exactly opposite one another in the housing. The space between the contact points of each set of limit switches is called the "null" band.) Accuracies of ± 0.005 inch, depending on the mass and weight of the load or type of application, are said to be possible. *Hanna Engineering Works*, Dept. R-26, 1765 Elston Avenue, Chicago 22, Ill.

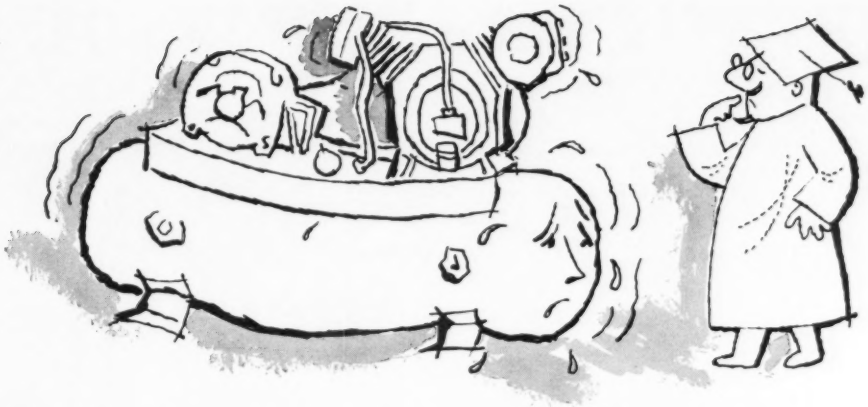
THE PIPE thermometer illustrated simply clips to gas, steam, water, refrigeration and other lines by means of twin spiral spring clips supplied with each instrument. They can be used for all pipes to $3^1/_2$ inches in diameter. The instruments can be attached or removed from the pipes in seconds and require no alteration of the piping systems. This eliminates any need for branching or drilling. The thermometers are precalibrated to counteract the possibility of error through heat losses by radiation or convection, and each has a dial $2^1/_2$ inches in diameter, silvered with black figures and polished chrome casings. The thermometers are graduated in 2-degree divisions, and come in two temperature ranges: Model No. APFT 460, for the range from plus 32° to 320° F; and Model No. APFT 461, for the colder



ranges of minus 14° to plus 134° F. A descriptive data card will be sent upon request. *Abrax Instrument Corporation*, 179-15 Jamaica Avenue, Jamaica 32, N. Y.

AN AUTOMATIC counting device, which is said to assure accurate counts on any type of equipment controlled by pneumatic or hydraulic action, is offered by Pneumaticount. Such counters are widely used in industry for plywood machinery, metering devices in the oil industry, punch and hydraulic presses, phonograph record machines, paper mill machinery, etc. The counters screw into the line controlling the air cylinder and can be installed in 5 minutes. There is no linkage to assemble or jam, no solenoid, and no possibility of half- or miscounts, according to the manufacturer. Particularly adapted for heavy-duty use, with a tamper-proof key reset, stainless steel parts, and totally plated weatherproof cases, the Pneumaticount may well out wear and out perform mechanical counters, even though it costs less than the usual installation costs. All models are available with five or six digits, 300 counts per minute. *Pneumaticount*, 3400 N. E. Fifty-Fourth Avenue, Portland, Ore.

"I'm worried about that thumb."



why an overworked air compressor

can rob your profits...

LOW AIR PRESSURE at portable air tools or air-operated equipment produces the same condition as a dull saw: It requires more operator effort; the job takes longer; you're wasting manpower.

IF YOUR DISTRIBUTION SYSTEM is adequate and lines are tight, low tool pressure indicates the need for more compressor capacity . . . Your Ingersoll-Rand AIRengineer can quickly help you determine how much and where additional compressor capacity will give you faster, more profitable production. Call him today at your nearest I-R Branch Office or authorized distributor.

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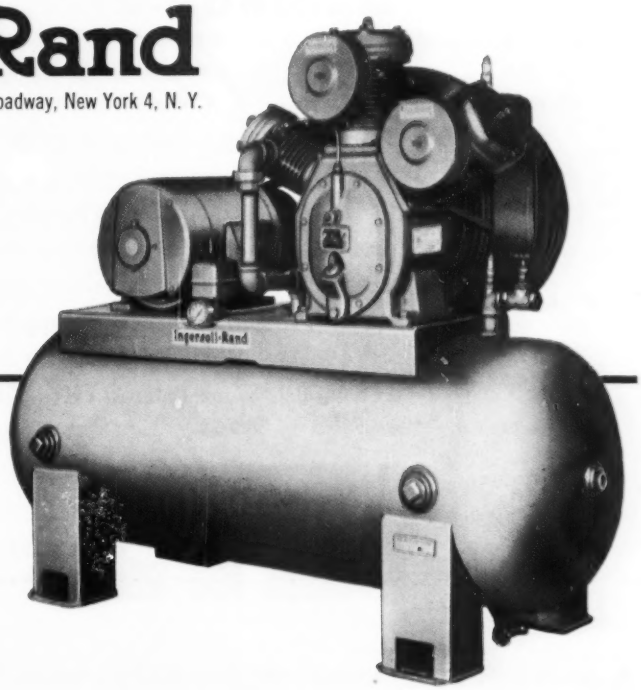
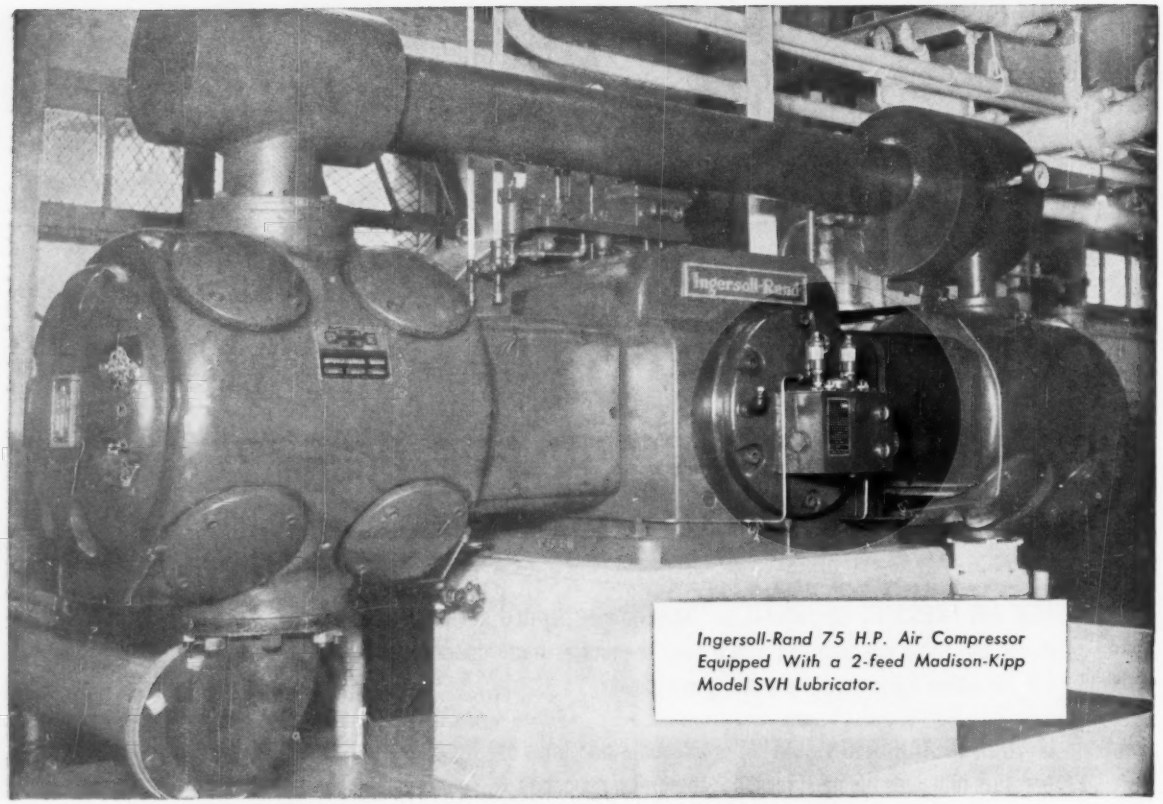


Ingersoll-Rand Type 30
Air-Cooled Air Compressor
½ through 20 hp



Ingersoll-Rand 75 H.P. Air Compressor Equipped With a 2-feed Madison-Kipp Model SVH Lubricator.

Machines of great performance use the most dependable oiling system ever developed

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Fresh Oil ... by the measured drop, from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy, where oil under pressure fed drop by drop can be installed. There are 6 models to meet almost every installation requirement.

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- Experienced in Lubrication Engineering
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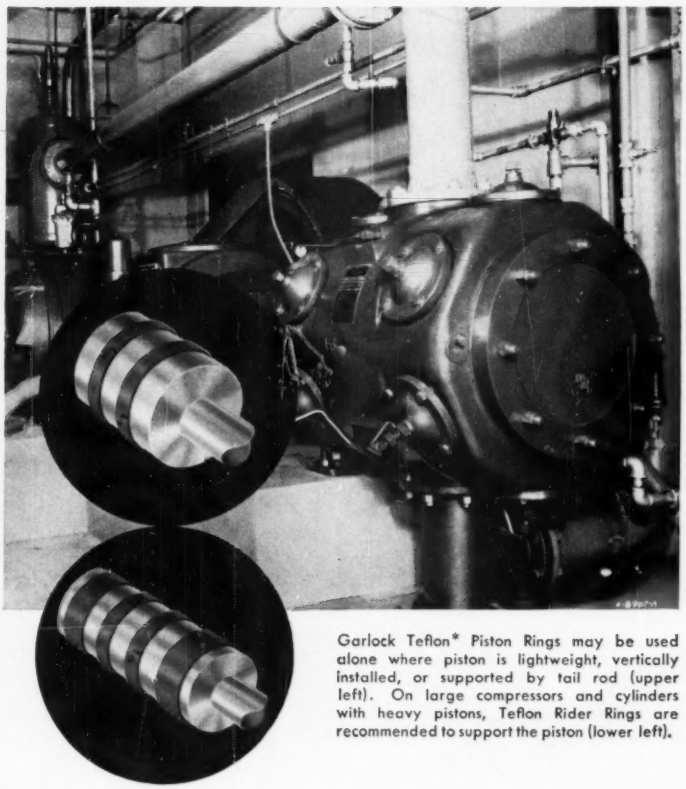
NEW ENGINEERED TEFLON PISTON RINGS

for Non-Lubricated Service



Garlock Teflon* Piston Rings may be used alone where piston is lightweight, vertically installed, or supported by tail rod (upper left). On large compressors and cylinders with heavy pistons, Teflon Rider Rings are recommended to support the piston (lower left).

Time after time, Teflon Piston and Rider Rings—the newest of Garlock products—prove effective in extending ring life under non-lubricated or chemical service.

A compressor used in wet hydrogen service was fitted with six rings of Teflon. Lubrication was eliminated and the rings were still in service after 2000 hours. Cast iron piston rings previously used needed lubrication and lasted less than 100 hours.

Another compressor operated at +350°F to supply instrument air. With Teflon Piston Rings, the compressor has been in continuous service for over 2500 hours without lubrication; the radial wear rate is approximately .009 per 1000 hours. Before this, the cylinder had to be lubricated; it was also necessary to periodically remove oil from the discharge air to prevent entry into instrument air lines.

The first really satisfactory piston rings for non-lubricated service, Garlock Teflon Piston and Rider Rings are engineered for longer life and better heat dissipation. They have the lowest coefficient of friction of all materials, are chemically inert, and will not contaminate the gas or fluid in the system. Garlock Teflon Piston and Rider Rings will not crack or break, will not score cylinder walls, and are flexible for easy installation. They can be applied at temperatures from −420°F to +500°F, are available in carbon-graphite filled Teflon or glass-filled Teflon, and come in either butt joint, step joint, scarf cut or solid, depending on your needs.

Talk to your Garlock representative about Teflon Piston and Rider Rings. He is backed by years and years of experience in the design, manufacture and application of packings and seals of all types. You will find him in your locale at the nearest of the 26 Garlock sales offices throughout the U.S. and Canada. Or, write for Catalog AD-178. Garlock Inc., Palmyra, New York.

GARLOCK

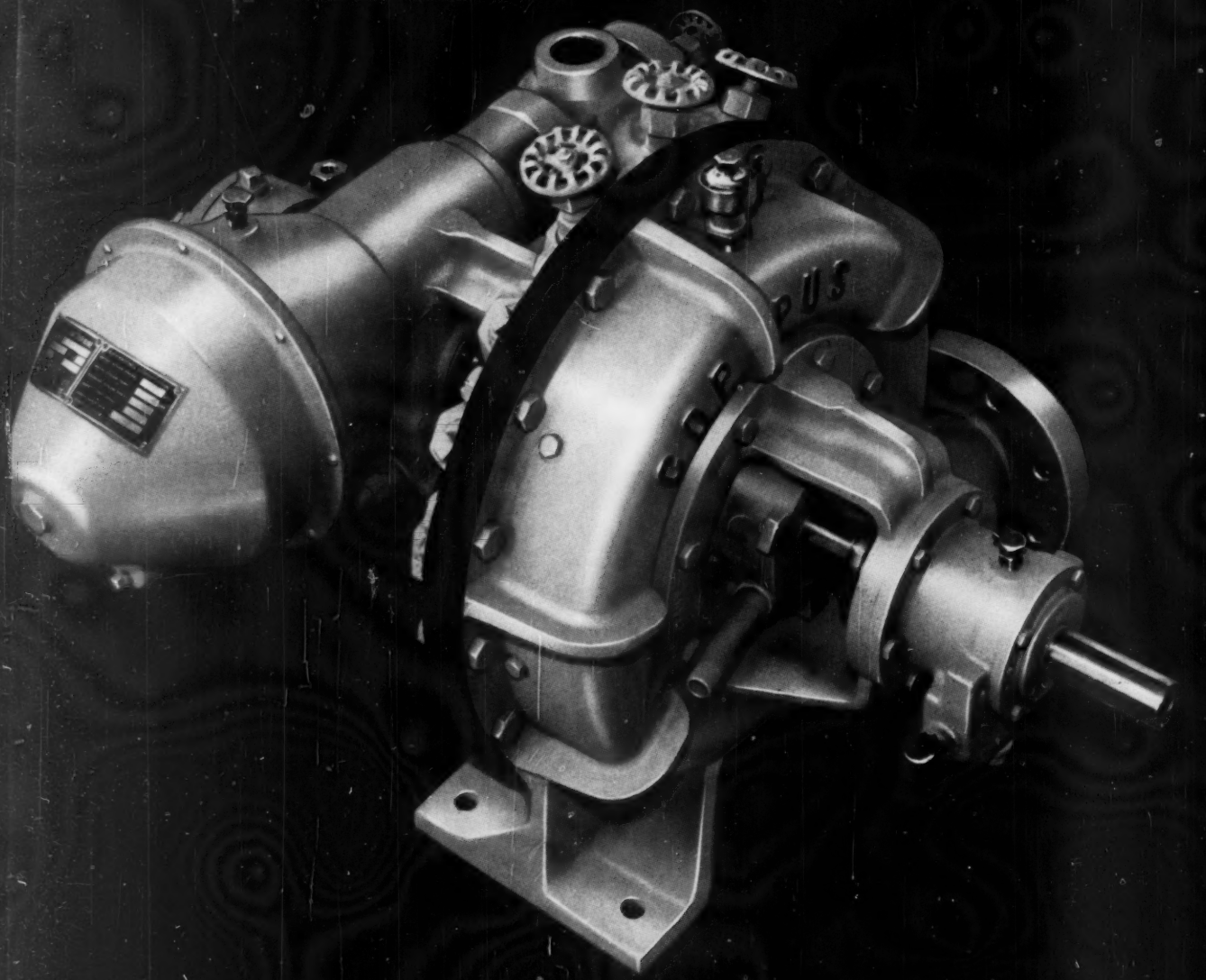
Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*DuPont Trademark

COPPUS BLUE RIBBON PRODUCTS



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NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY!
Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 202 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

GET REAL PRODUCTIVITY—GET A GM DIESEL

It doesn't take long for blowing sand and dust to separate the men from the boys in the engine league. And you can take it from "Bud" Mentzer, Equipment Superintendent for Phoenix' Fisher Contracting Corp., that "Jimmy" Diesels do a man-sized job even under these tough conditions.

He'll prove it by pointing to the "3-71" GM Diesel he's got powering his Ingersoll-Rand 315 compressor—tell you he's gotten 7,500 trouble-free hours from the "Jimmy" and it's still going strong. It's had only one overhaul even though it's worked almost constantly in blowing sand and dust—has barely had a minute's unscheduled downtime since it hit the job.

And this is just one of 19 GM Diesels Fisher has powering scrapers, tractors, compressors, loaders, trucks, a shovel and lighting plant. The company has been using "Jimmys" since 1942, recently repowered five more pieces of equipment with GM Diesels.

Less downtime, better availability, reduced operating costs, higher productivity—these are some of the advantages you get *from* your equipment with GM Diesels *in* your equipment.

Want to know more? See your GM Diesel distributor—he's in the Yellow Pages under "Engines, Diesel"—or write direct.

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GENERAL MOTORS, DETROIT 28, MICH.

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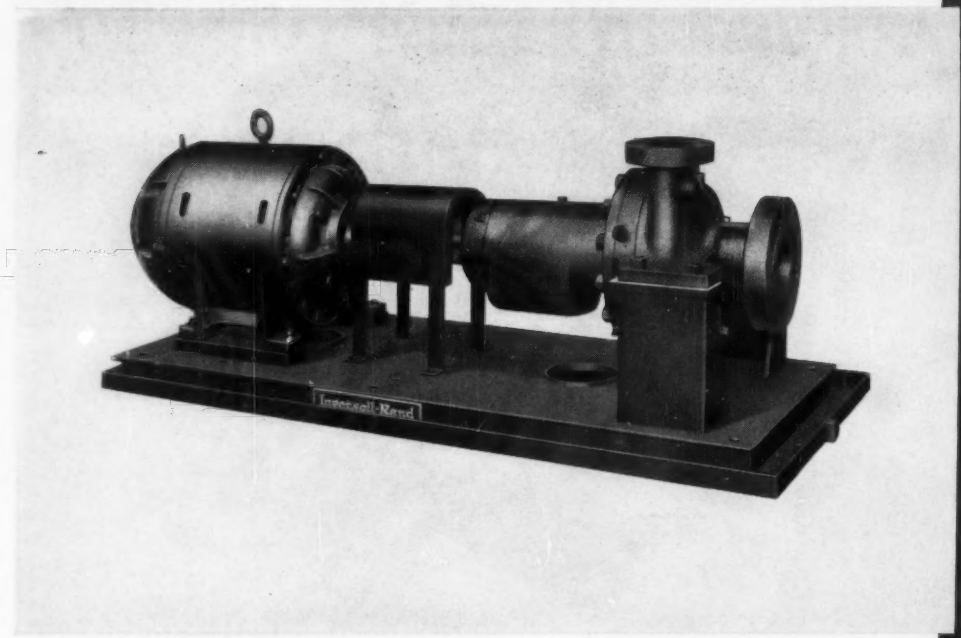
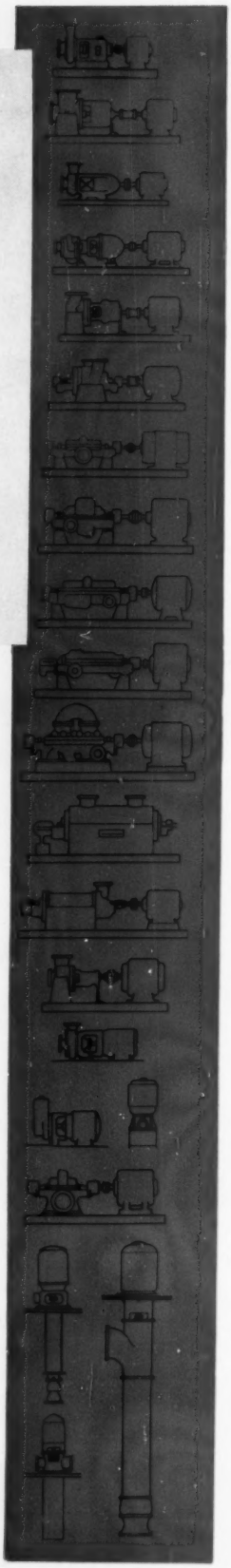
Parts and Service Worldwide

GM DIESEL ALL-PURPOSE POWER LINE sets the standard of Diesel productivity

● **The latest addition to Ingersoll-Rand's extensive Process Pump Line**





NEW *Centerline mounted* Process Pump with integral Mechanical Seal for heads to 650 ft., temperatures to 250° F.

Ingersoll-Rand introduces a pump that is designed around the modern concepts of integral mechanical sealing, centerline mounting, ease of operation and maintenance *at lower first cost.*

Designed for handling light refinery liquids such as oils, LPGs, distillates and solvents, these pumps feature an integral single mechanical shaft seal which efficiently stops liquid losses and reduces stuffing-box attention to a minimum. The seal can be arranged for internal or external circulation. The casing is cast steel and is arranged for end suction and top discharge.

Complete Range of Sizes – The line includes 1, 1½, 2, 3 and 4 inch units with 14 basic impeller sizes covering a range of capacities to 1400 gpm and heads to 650 ft. Maximum working pressure is 400 psig. Maximum working temperature is 250°F.

Thoroughly Proven Design – Ingersoll-Rand introduced the Industry's first process pump with a built-in seal as standard equipment in 1951. All of the proven design features have been incorporated in these pumps.

Rugged, Long-Life Construction – Designed for moderate pressures and temperatures of many modern refining, petrochemical and chemical processes. A short rugged shaft, heavy-duty angular contact thrust bearing and deep groove radial bearing provide a rugged design that means long pump and seal life.

Maximum Parts Interchangeability is provided throughout the complete line. In addition, parts are interchangeable with most other types of Ingersoll-Rand vertically-split process pumps thereby greatly reducing spare part inventories.

Your nearest Ingersoll-Rand engineer will be glad to tell you more about these new pumps and help you select the best unit for your application. Ingersoll-Rand makes the world's most complete line of process pumps. There's one that's *right* for you.

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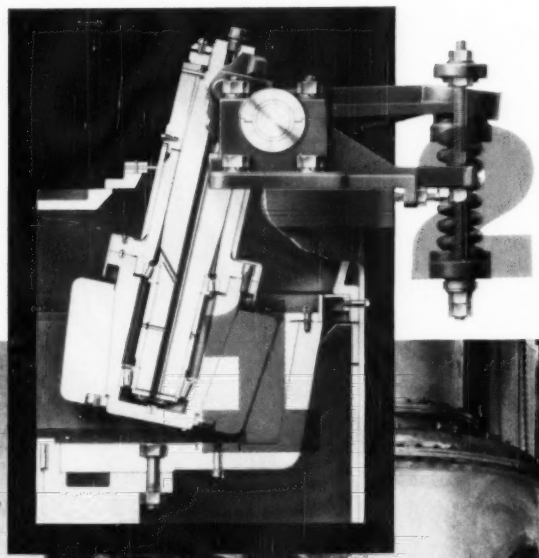
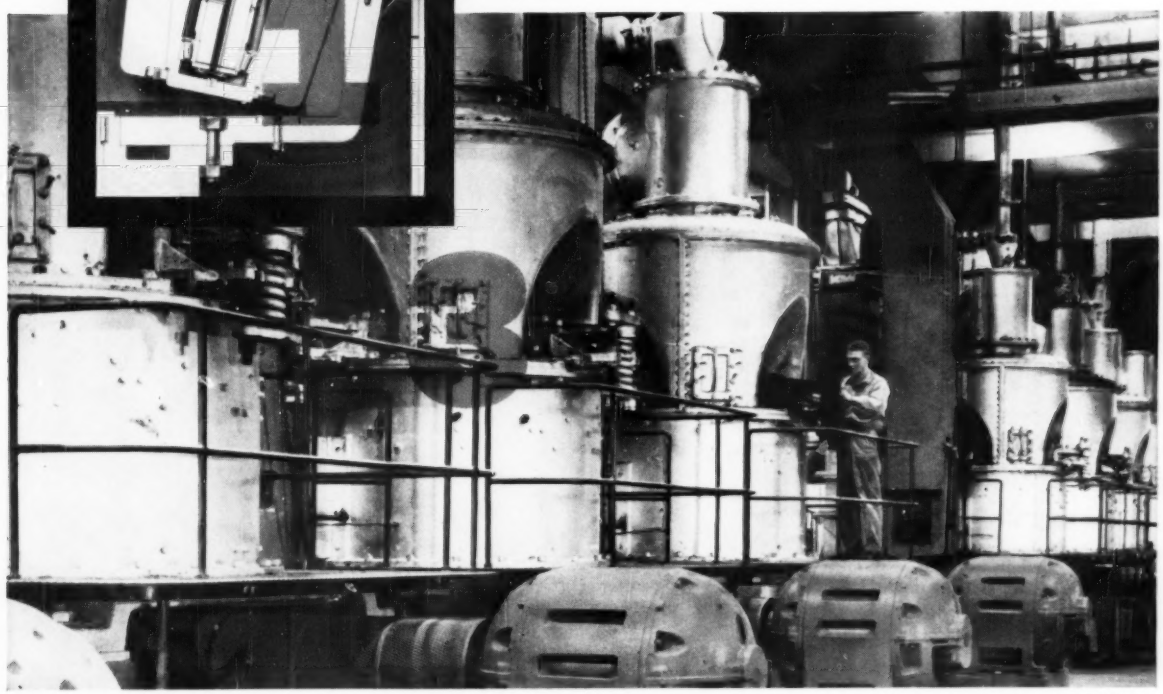
ADVERTISERS INDEX

If you pulverize coal, look into these 3 major advantages of C-E RAYMOND BOWL MILLS



1. Operate longer between outages
2. Compensate automatically for grindability variations
3. All adjustments and lubrication made from *outside* the mill



Handles coals of even 50% moisture content quickly...easily

Since 1935, when the C-E Raymond Bowl Mill was introduced, more than 3,000 have gone into service in power plants all over the world. They operate continuously for many thousands of hours with minimum maintenance care.

As the inset shows, there is no metal to metal contact between the grinding elements, even when the mill runs empty. This gives you lower wear, quieter operation, less frequent replacement of parts.

The grinding rolls are mounted on spring-loaded journals which automatically adjust to variations. Fineness control adjustments and replenishment of the lube system are made from outside the mill – without shutting it down.

You can handle coals like lignite – with 50% moisture – trouble free. The incoming raw coal is premixed with coal already dried in an atmosphere up to 800 F air for rapid, thorough drying. And you are assured of low power consumption by the low weight of the grinding elements, quick drying, and rapid flow of material through the mill.

For full details on the many other features of C-E Raymond Bowl Mills write for catalog PC-8.

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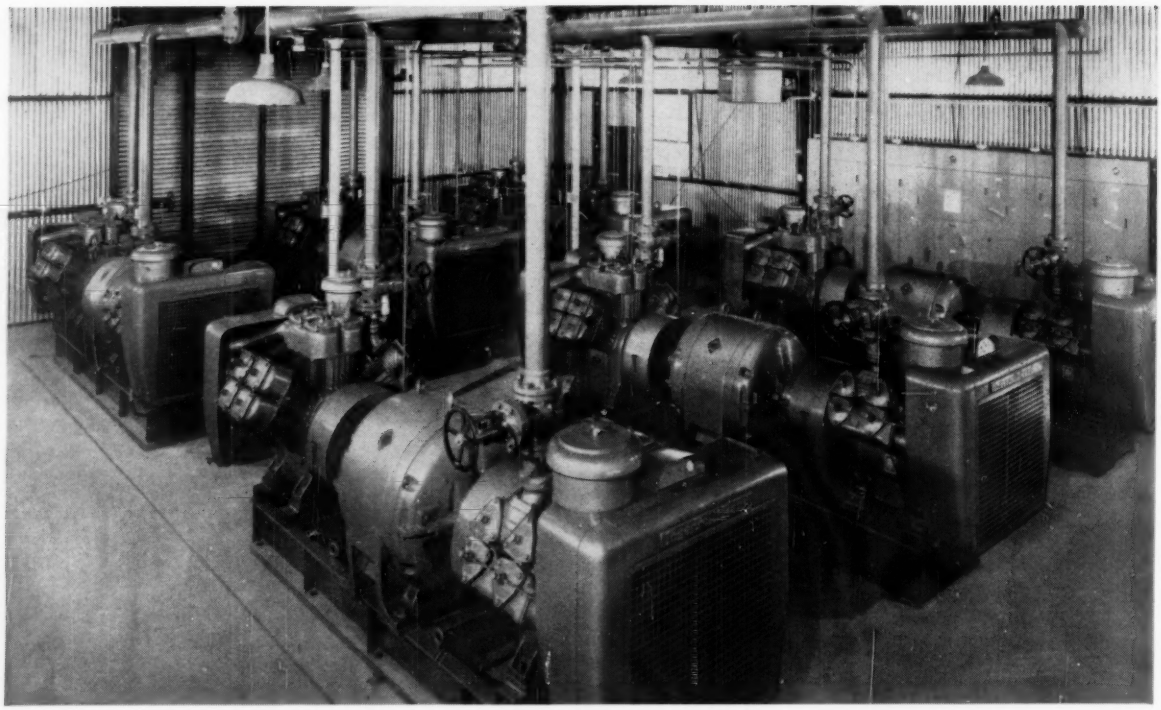
How I-R Compressor keeps air flowing at low cost



These Type 40 Ingersoll-Rand compressors supply air for a utility's propane-air mixing plant that handles peak loads on the company's natural gas pipeline. To assure dependable, economical air supply, Ingersoll-Rand mounts the compressor crankshafts on Timken® tapered roller bearings.

Timken bearings hold the crankshaft in positive alignment, practically eliminate friction. Their tapered design lets them take *both* radial and thrust loads. Crankshaft stresses are lower because the use of Timken roller bearings shortens the distance from the center of the main bearing to the center of the crankpin. Crankshaft wear is virtually eliminated; wear on adjacent parts is minimized. And because Timken bearings hold shafts concentric with their housings, they make closures more effective in keeping lubricant in, everything else out.

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Industry rolls on

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